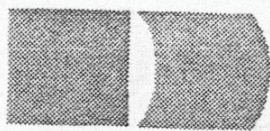


**71 SERIES
OSCILLOSCOPE
TIMEBASE 1X2**



DYNAMCO

CHERTSEY · SURREY · ENGLAND

Telephone: Chertsey 2636 Telex: 263387 Cables: Dynamco Chertsey



Issue 2 Nov. 1969

1X1/2/6

Sweep Modes

- (A) Timebase 'A' triggered directly.
- (B) Timebase 'B' intensified by 'A'.
- (C) Timebase 'A' starts after delay.
- (D) External sweep (both timebases off).

Delay Time Range

10 μ s to 0.5 secs continuously variable by 10 turn multiplier.

Delay Time Jitter

Less than 1 part in 10000 of maximum available delay time.

Weight

6.13 lb (2.78Kg).

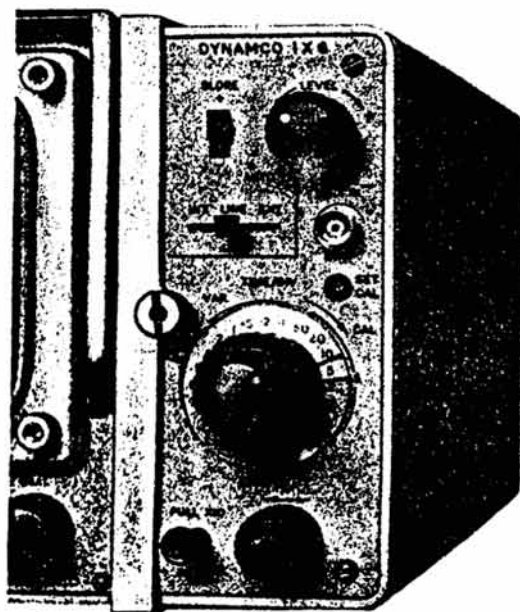
1X6 TIMEBASE MODULE

The type 1X6 timebase module is a simplified version of the 1X1 wide range timebase. It is intended to provide in a minimal width (2 $\frac{3}{4}$ in., 7cm.) most of the facilities required for general purpose applications.

Calibrated Sweep Rates

0.5 μ s/division to 0.2 secs/division in 19 calibrated steps (1, 2, 5 sequence). A fine control provides continuous uncalibrated variations between steps and extends the range to 0.5 secs/division (5 second sweep).

Accuracy 5% on all calibrated ranges (including X10 magnifier).



Magnifier

Switched X1 and X10, and extends the fastest sweep rate to 50ns/division.

Deflection Factors

X1:1V/division } Max. signal $\pm 5V$ about earth.
X10:100mV/division }

Frequency Response. 3Hz to >1.5MHz -3dB, X1 and X10.

Sweep Modes

- 'Internal Sweep'
- 'External Sweep'

Trigger

Modes (A) Triggered

(B) Auto

Source (A) Internal

(B) External

(C) Line

Coupling AC

Slope Positive, negative.

Level (A) Internal, adjustable through ± 2.5 divisions.

(B) External, $\pm 3V$.

Sensitivity (A) Internal, 0.2 division up to 10MHz, 0.5 up to 15MHz

(B) External, 0.2V.

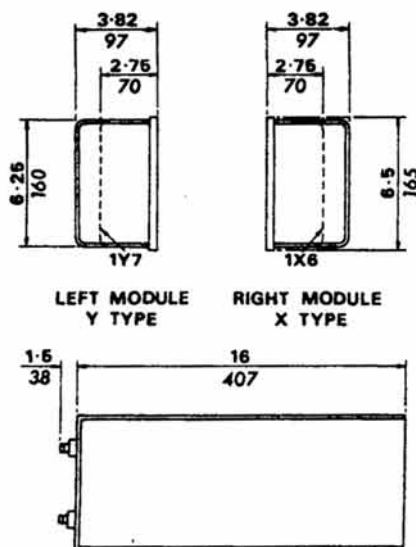
Trigger Input RC

1M Ω shunted by 30pF.

Shift

Enables any portion of displayed trace to be centred.

Weight 4 lb (1.82Kg).



Dimensions in Inches
Dimensions in Millimetres

These sizes can be obtained in blank metalwork — see Accessory Data Sheet.

Dynamco Limited, Chertsey, Surrey.
Telephone: Chertsey 2636.

— Subject to alteration without notice.

Magnifier

Switched X1 and X10 and extends the fastest sweep rate to 20ns/division. In addition the magnifier may be used to set the external input deflection factor, when the timebase is switched to 'Ext. Input'.

Deflection Factors:

X1:1V/division } Max. signal $\pm 5V$ about
X10:100mV/division } earth.

Frequency Response: DC to $>1.5\text{MHz}$ -3dB,
X1 and X10.

Sweep Modes

- (A) External sweep
- (B) Internal sweep
- (C) Single shot (for photographic applications).



Shift

Enables any portion of displayed trace to be centred.

Weight

5.5 lb (2.5Kg).

1X2 DELAYED SWEEP TIMEBASE

The type 1X2 is a timebase module used to provide normal and delayed sweeps. The module contains two timebases, one of which 'A', is intended for a main sweep, the other 'B', for delaying the start of timebase 'A'. Fine delay is achieved by using a comparator circuit controlled by a calibrated 10 turn knob.

During delayed operation, pulse location is simplified by the use of a Bright-up Strobe ('B' intensified by 'A'). To vary the 'hold off' period for maximum repetition rates, the 'B' timebase has a variable velocity control with two calibrated positions (X1 and X5).

Timebase A

The A timebase is identical to the 1X1 timebase with the following exceptions:-

Calibrated Sweep Rates

0.2 μs /division to 0.2secs/division in 19 calibrated steps (1, 2, 5 sequence). A fine control with calibrated positions provides continuous uncalibrated variations between steps and extends the range to 0.5secs/division (5 second sweep).

Trigger

The Auto mode is on the A timebase only. The Line trigger source is not available.

Timebase B

Sweep Rates

10 μs /division to 10ms/division in 4 calibrated ranges (decade steps). A fine control with calibrated position extends the sweep rate to 50ms/division (0.5 second sweep).

Accuracy 5% on all calibrated ranges.

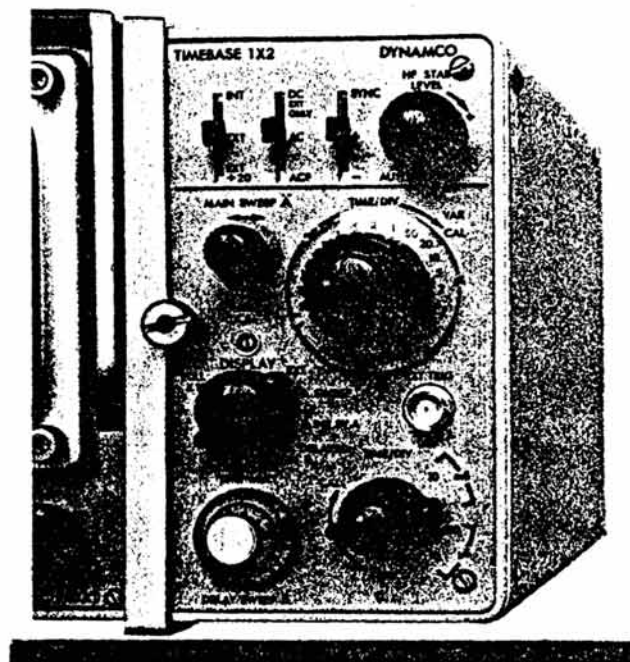
Magnifier

Switched X1 and X10, and extends the fastest sweep rate to 20ns/division. In addition the magnifier may be used to set the external input deflection factor when the timebase is switched to 'Ext. Input'.

Deflection Factors

X1:1V/division } Max. signal $\pm 5V$ about
X10:100mV/division } earth.

Frequency Response DC to $>1.5\text{MHz}$ -3dB,
X1 and X10.



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1. INTRODUCTION

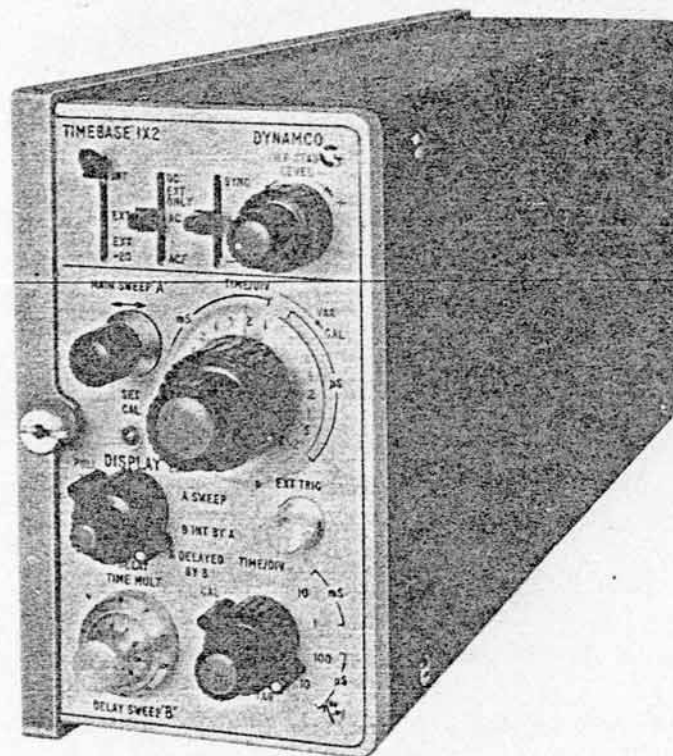


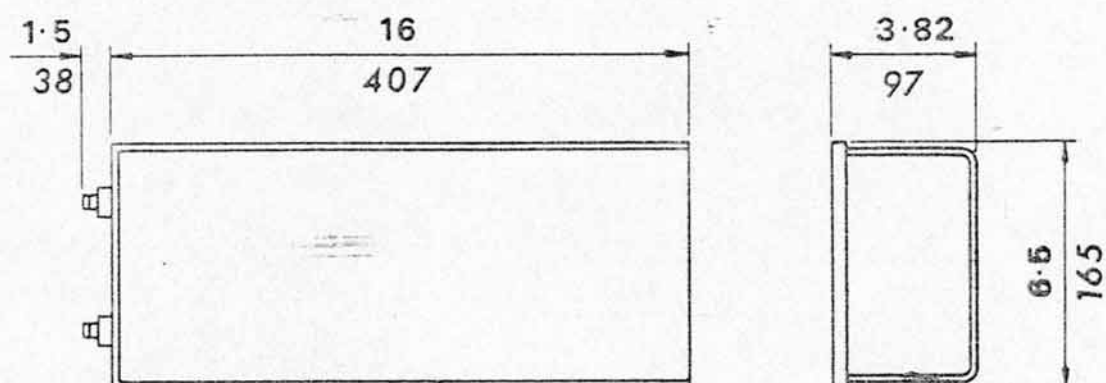
Fig. 1. Delayed Sweep Timebase 1X2 - General View

The delayed sweep timebase module 1X2 is designed for use with the Dynamco 71 series oscilloscope display units.

The module has two timebases which may be used to provide either normal or delayed sweeps. Timebase A is intended for the main sweep and timebase B for delaying the start of timebase A. Fine delay is achieved using a comparator circuit controlled by a calibrated 10 turn knob. During delayed operation, pulse location is simplified by the use of a bright up strobe (timebase B intensified by timebase A). To vary the 'hold off' period for maximum repetition rates, the B timebase has a variable velocity control with a calibrated position.

The module is of the plug on type. It slides on to the side of the display unit (normally right hand side) and is locked in position by a single finger screw. All printed circuit boards are made from glass fibre and are marked with component and connecting tag identifications. Transistors plug in for 'out of circuit' checking.

An operating instruction booklet giving condensed details of operation and specification of all 71 series modules is located in a pocket beneath the display unit.



Weight 6.125 lb 2.78 kg

Dimensions in Inches

Dimensions in Millimetres

DELAYED SWEEP TIMEBASE 1X2 - DIMENSIONS

FIG.2

2. SPECIFICATION

2.1 DISPLAY

CATHODE RAY TUBE	5 in. (12.7 cm) rectangular face plate, mesh screened P.D.A. <i>D13-51 Brinnan</i>
SPOT SIZE	0.4 mm nominal. <i>1300Q GEC/MOV</i>
PHOSPHORS	P31 as standard. Others, including P2, P7 and P11 available.
GRATICULE	External, 10 divs. by 6 divs. in cm divisions with 2 mm subdivisions on major axes.
ILLUMINATION	Edge lit, variable intensity.
ACCELERATING VOLTAGE	Approximately 10KV overall.
UNBLANKING	D.C. coupled to CRT grid.
EXTERNAL Z MODULATION	D.C. coupled via unblanking amplifier. Input Resistance: 10K Ω Input Voltage: 5V gives noticeable modulation at normal brilliance.
OPERATING TEMPERATURE (AMBIENT)	0 to 50°C maximum. Note that in a rack, temperatures may rise appreciably above ambient.

2.2 CALIBRATOR

WAVEFORM	Approximately square.
POLARITY	Positive going from baseline at zero volts.
AMPLITUDES	50mV, 500mV and 5V.
ACCURACY	$\pm 2\%$
REPETITION RATE	1KHz $\pm 2\%$
RISE TIME	Not greater than 1 μ s
FALL TIME	Not greater than 5 μ s

Sensitivity: Internal 0.2 division.
 External 100mV.
 External $\div 20$, 2V.

Input RC: $1M\Omega$ shunted by 30pF.

SHIFT

3-turn control enabling any portion of displayed sweep to be centred.

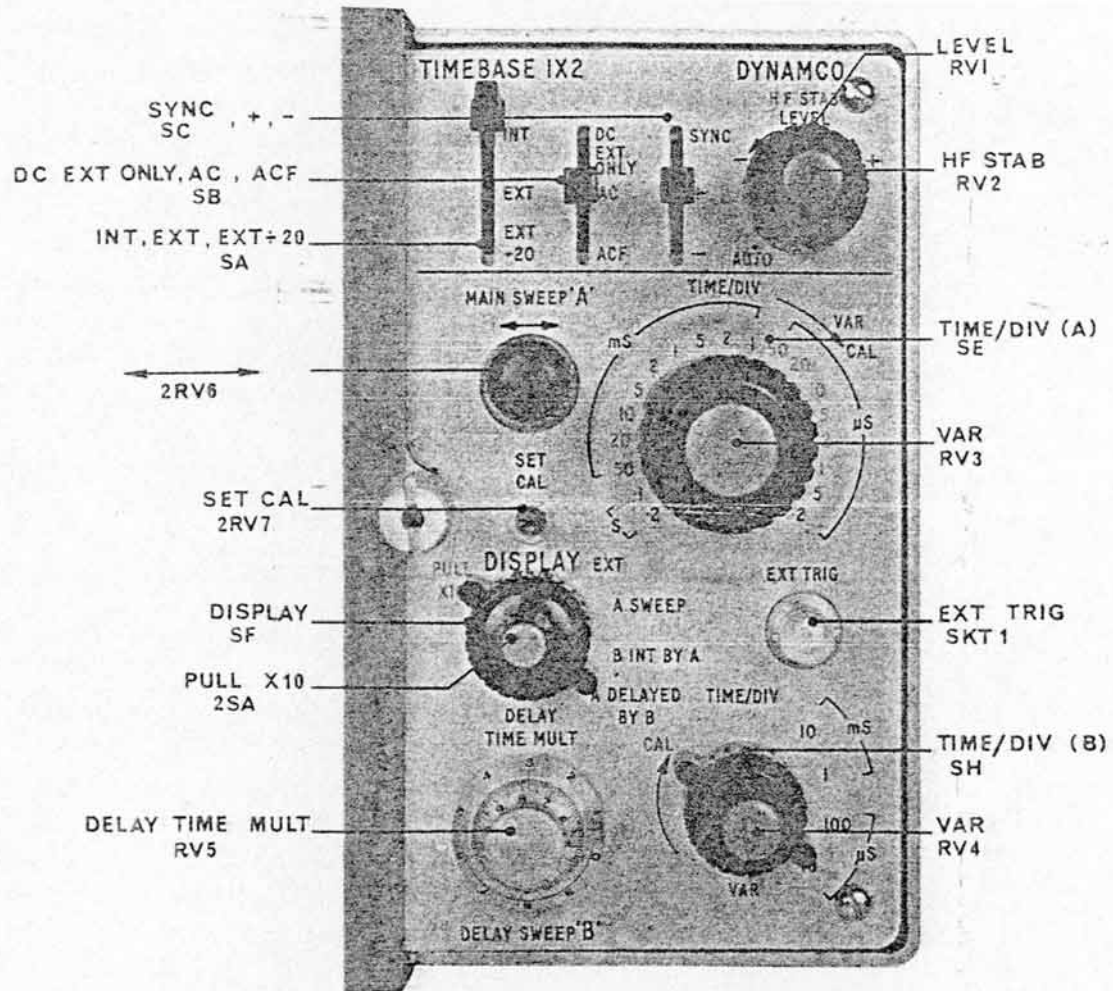


Fig. 3. Delayed Sweep Timebase 1X2 - Controls

3. OPERATING INSTRUCTIONS

3.1 CONTROL FUNCTIONS

The location of the front panel controls are shown on Fig. 3 and details of their functions are given in Table 1.

TABLE 1. CONTROL FUNCTIONS

CONTROL		FUNCTION
Trigger Input Condition Switches	Source 'INT' 'EXT' 'EXT - 20'	A three position lever type switch, used to select the sweep triggering signal. When in the INT position, the signal from the Y module is used as the trigger. When in the EXT or EXT $\div$ 20, (20 : 1 frequency compensated attenuator) an externally derived signal applied at EXT TRIG socket is used as the trigger
	Coupling 'DC EXT ONLY' 'AC' 'ACF'	A three position lever type switch which selects one of three coupling networks DC, AC or ACF (a.c. fast). The D.C. mode is designed for external use only; in the ACF mode, a filter having a 22 μ s time constant attenuates LF signals.
	Slope 'SYNC' '+' '-'	A three position lever type switch which gives a choice of either positive or negative slope triggering. If the start of the display is required to occur when the triggering signal rises (i.e. +ve slope), the control must be set to +. When set to SYNC, a recurring horizontal sweep results, providing the LEVEL control is fully anti-clockwise. Clockwise rotation of the LEVEL control provides synchronization.
LEVEL		Selects the voltage level on the trigger waveform at which the sweep is triggered. With LEVEL in the + region, the trigger circuit responds to a more positive point on the trigger signal. In the - region, the trigger circuit responds to a more negative point on the trigger signal. (See Fig. 4.)

CONTROL	FUNCTION
HF STAB	This control is used to vary the hold-off time, thus enabling the timebase to maintain a stable count down at high repetition rates. It has very little effect at lower repetition rates. When set to the AUTO position (fully anti-clockwise) in the absence of a trigger, the sweep free runs.
TIME/DIV (A sweep)	This is a 19 position switch which provides control of the A timebase velocity from $0.2\mu\text{s}/\text{division}$ to $0.2 \text{ secs}/\text{divisions}$ in 1, 2 5 steps. The steps are only calibrated when the red control is in the fully clockwise position.
VAR	The red, concentric, VAR part of the TIME/DIV switch provides continuous variation between each step and extends the sweep rate to at least $0.5 \text{ secs}/\text{div}$.
X Shift 	This control adjusts the position of the trace(s) on the horizontal axis.
DISPLAY	EXT : Signals may be applied directly to the X Amplifier via the X I/P socket at the rear. A SWEEP: Internal timebase operation. B INT BY A: The B timebase is triggered normally and after a time set by the DELAY TIME MULT control, and B TIME/DIV switch, timebase A fires. The position and period of timebase A is superimposed on B as a brightness marker (providing A runs faster than B). A DELAYED BY B: The intensified portion of B is displayed by A.

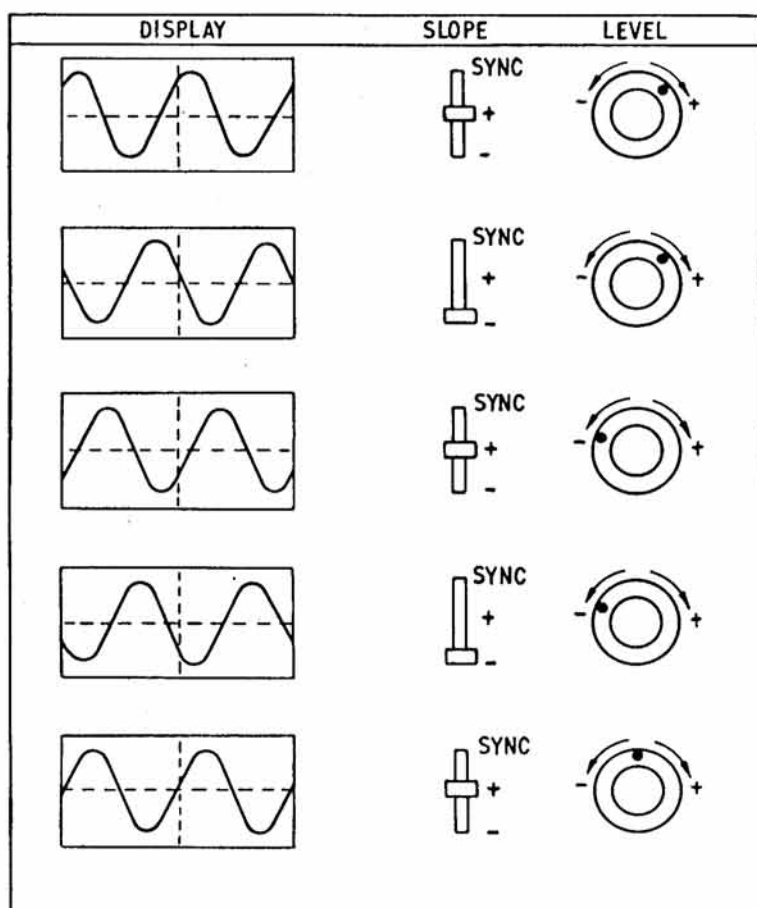


Fig. 4. Operation of LEVEL and SLOPE Controls

TABLE 1 (Cont'd.)

CONTROL	FUNCTION
PULL X10	The red, PULL X10 concentric part of the control amplifies the horizontal display ten times.
SET CAL	A preset screwdriver control used to adjust the horizontal display calibration.
TIME/DIV (B sweep)	A four position switch which provides control of the B timebase velocity from $10\mu\text{s}/\text{division}$ to $10\text{ms}/\text{division}$ in decade steps. These steps are only calibrated when the red control is in the fully clockwise CAL position.

CONTROL	FUNCTION
VARIABLE	The red, concentric VARIABLE part of the TIME/DIV switch provides variation between CAL and x 5 and extends the sweep rate to 50ms/division. (Maximum delay time 0.5 sec).
DELAY TIME MULT.	This control provides a variable sweep delay between 1 and 10 times the delay indicated by the B TIME/DIV control.
HF STAB	This control is used to vary the hold-off time, thus enabling the timebase to maintain a stable count down at high repetition rates. It has very little effect at lower repetition rates. When set to the AUTO position (fully anti-clockwise) in the absence of a trigger the A sweep free runs.

3.2 OPERATION

The following instructions assume that the delayed sweep timebase module 1X2 is fitted to a display unit, and Y-amplifier module which are correctly calibrated.

Initial Calibration

Calibration is necessary when a new or replacement timebase module is fitted or after replacement of a faulty component. Proceed as follows :-

- (1) Set the BRILL, FOCUS and ASTIG controls on the display unit to their midway position.
- (2) On the Y module, set the controls as follows :-

VOLTS/DIV	:	10mV	
VARIABLE	:	CAL (fully clockwise)	
AC, DC, GND	:	AC	
PULL X10	:	In	
Shift	:	Midway	
Mode	:	CH1	)
Trigger	:	CH1 TRIG	)
PULL INV	:	In	)

Dual Channel
Amplifier 1Y2 only.

(3) On the timebase module, set the controls as follows:

	(	Source INT, EXT, EXT $\div$ 20	:	INT
Trigger	(	Coupling DC EXT ONLY, AC, ACF	:	AC
	(	Slope SYNC, +, -	:	+
		HF STAB	:	AUTO (fully counter-clockwise)
		LEVEL	:	Midway
'A'		TIME/DIV	:	1ms
'A'		VAR	:	CAL (fully clockwise)
		PULL X10	:	In
		DISPLAY	:	'A' SWEEP
		DELAY TIME MULT	:	5
'B'		TIME/DIV	:	1ms
'B'		VARiable	:	Fully clockwise

(4) Connect a short, screened jumper lead between the 50mV socket of the display unit and the input socket on the Y module (use channel 1 for 1Y2 module).

(5) Switch on with the GRAT control on the display unit and check that the red supply lamp glows; adjust the BRILL, FOCUS and ASTIG controls to give the best trace. Adjust the GRAT control to provide the required graticule illumination level.

NOTE: Full measuring accuracy will only be available 15 minutes after switch on. If, after this period full accuracy cannot be achieved, the SET CAL control must be adjusted as follows:

(6) Set the AC, DC, GND control on the Y module to AC.

(7) Check that the trace is locked. If not, adjust the LEVEL control.

(8) Set the 'A' VARIABLE control to CAL (fully clockwise) on the 1X2 module.

(9) Adjust the SET CAL preset control on the 1X2 module so that the display shows exactly 1 cycle/division.

NOTE: If the trace is not parallel with the graticule, adjust 2RV50 located on the front panel behind the handle to the right of the c.r.t. On some models, the trace rotate control is mounted on the X amplifier board in the display unit. Slide the top cover back to gain access to the X amplifier board.

THE OSCILLOSCOPE IS NOW CALIBRATED AND READY FOR SERVICE.

External Mode

(1) Set DISPLAY control to EXT.

(2) Connect an external signal to the X I/P socket at the rear of the 1X2 module. A suitable capacitor may be used to remove d.c. components if necessary (input impedance 1M Ω).

- (3) Adjust BRILL control on the display unit.
- (4) Centre trace with the shift control on the 1X2 module.

A Sweep Mode

- (1) Set DISPLAY control to A SWEEP.
- (2) Set TIME/DIV control to suit display required.
- (3) Set trigger source control as follows :-

INT	:	If triggering from Y module.
EXT or EXT $\div$ 20	:	If triggering externally at the EXT TRIG socket.
- (4) Set trigger coupling control as follows :-

DC EXT ONLY	:	DC and low frequency trigger only; applied at EXT TRIG socket
AC	:	For 5Hz to 50MHz trigger or SYNC signals.
ACF	:	To eliminate unwanted low frequency signals and for mixed trigger operation.
- (5) Set trigger slope control to + or - depending on the slope of the waveform at the point from which the display is to start.
- (6) Apply the trigger signal and set the trigger point by adjusting the LEVEL control.

NOTE: Triggering details are given in a later section.

Delayed Sweep Mode

Delayed sweep operation is most used as a means of expanding in time a small portion of a recurring waveform of the type produced for example, in television and computer circuits. The required portion is identified by means of a brightening intensification of the trace. In setting the controls to achieve this, the delay time of the B timebase and period of the A timebase are set so that the brightened portion of the traces covers that part of the signal to be expanded. The A timebase may then be switched to display this part of the trace across the full width of the c.r.t. The apparent magnification by this method can be as much as x1000. To obtain a delayed sweep, proceed as follows :-

- (1) Set the DISPLAY control to B INT BY A and select a suitable trigger source, coupling and slope.

NOTE: AUTO must not be used for delayed sweep operation.

- (2) Adjust the B TIME/DIV and VAR controls to give a display time equal to or just greater than the maximum delay required.

- (3) Adjust DELAY TIME MULT until the leading edge of the bright-up marker is coincident with the beginning of that portion of the trace to be investigated.

NOTE: The leading edge of the bright-up should not be set to less than $\frac{1}{2}$ div. from the start of B (delaying sweep), or the A sweep trigger and bright-up will be lost.

- (4) Operate the A TIME/DIV control to give the required length of marker. Ensure that A TIME/DIV is faster than B TIME/DIV.
- (5) Set the DISPLAY control to A DELAYED BY B.
- (6) Fine adjustment to signal position can be made using the DELAY TIME MULT control.

NOTE: Further adjustment of BRILL may be needed.

Trigger Source Selection

The timebase in the 1X2 module may be triggered either internally or externally. Internal trigger signals (0.2 div) are derived from the Y module when the trigger source control is set to INT. External trigger signals are applied at the EXT TRIG socket. The timebase may be triggered by signals of peak-to-peak amplitude $\leq 100\text{mV}$ (EXT) or $\leq 2\text{V}$ (EXT $\div 20$).

Normal Triggered Operation

- (1) Set the controls as for A Sweep display (see above).
- (2) If AC or ACF coupling is used and the LEVEL control is anticlockwise from the midway position, the trigger point will be below (-ve) the mean level of the trigger signal; if it is clockwise, the trigger point will be above the mean level of the trigger signal.
- (3) If the LEVEL control is outside the limits of the trigger signal, the trace will not show and the READY lamp will glow.

Auto Triggered Operation

The main visual difference between normal and auto operation is that a bright trace is shown in the absence of a trigger signal when in AUTO; this indicates that the timebase is free running. The AUTO trigger can be used down to 10Hz, but is unsuitable for lower frequencies. Proceed as follows:-

- (1) Set DISPLAY control to A SWEEP.
- (2) Set A TIME/DIV control to suit display required.
- (3) Select trigger source as required.

- (4) Select trigger coupling as required.
- (5) Select trigger slope as required.
- (6) Set HF STAB control to AUTO.

On very small signals, or if the LEVEL control is set right on the threshold of the signal, the display will 'hunt' at about 10Hz. Increasing the signal or adjusting the LEVEL control will remedy this.

WARNING: DO NOT LEAVE 'AUTO' ON WHEN USING DELAYED SWEEP.

Use of the Slope Control

Details of the use of this control in the + and - position are given in Table 1 and Fig. 4. The SYNC mode is intended for use with signals having a pulse repetition frequency greater than 10MHz with either normal or automatic triggering. The timebase may be synchronized with the signal by adjusting the LEVEL control, providing the control is to the left of the vertical position.

For SYNC operation, proceed as follows:-

- (1) Set the slope control to SYNC
- (2) Set HF STAB to AUTO for auto triggering or off AUTO for normal triggering.
- (3) For automatic triggering, adjust the LEVEL control to obtain a stable display.

3.3 INTERCONNECTIONS

Interconnections are made via two 12-pole fixed plugs PLA and PLB (Fig. 5) which mate with fixed sockets SKTA and SKTB on the display unit. Connections to PLA and PLB are listed in Tables 2 and 3.

An external trigger signal may be connected to the front panel co-axial socket EXT TRIG (Fig. 3), while an external X input enters via a 2mm socket SKT3 X I/P on the back panel (Fig. 5). Further sockets on the back panel carry the signal outputs A GATE, A RAMP and B GATE. A GATE on SKT4 is a negative going pulse between -0.6V and -2.5V corresponding in time to the A timebase, and A RAMP on SKT5 is an attenuated timebase signal, 1V in amplitude positive going from 0V. B GATE is similar to A GATE but is derived from the B timebase. An earth point is provided at SKT2.

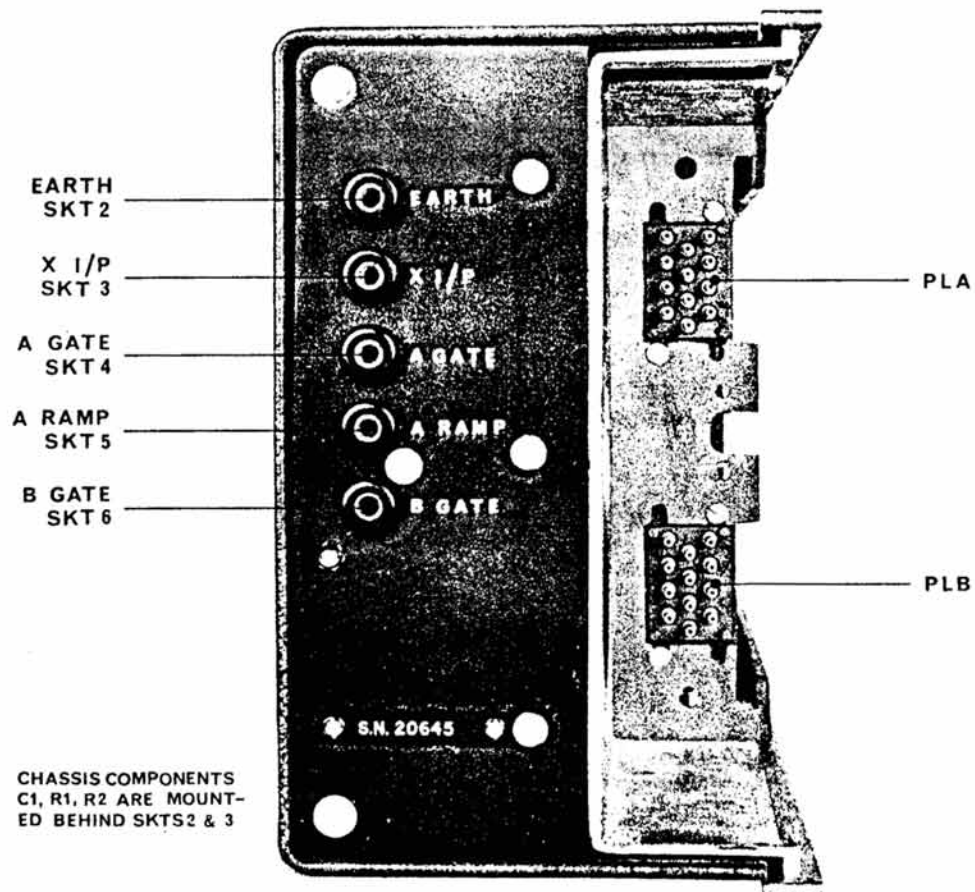


Fig. 5. Delayed Sweep Timebase 1X2 - Rear View

TABLE 2. CONNECTIONS TO PLA

PIN	FUNCTION	CURRENT
1	+117V	50mA
2	Not used	
3	+30V Unstab.	150mA
4	Not used	
5	+15V	110mA
6	0V	
7, 8	Not used	
9	-15V	160mA
10	Trigger +	
11	Earth	
12	Trigger -	

TABLE 3. CONNECTIONS TO PLB

PIN	FUNCTION	REMARKS
1	Amplifier Input +)	200mV/cm.
2	Earth)	
3	Amplifier Input -)	7.5mA negative
4	Bright-up Command - Live	
5	Display Gate)	
6	Earth)	
7	Alternate to Display Gate	
8	Earth	
9 to 12	Not used	

4. TECHNICAL DESCRIPTION

4.1 FUNCTIONAL DESCRIPTION

The 1X2 module includes three printed circuit boards, the trigger board, which includes the trigger amplifier, trigger pulse generator and auto logic circuit, the A timebase board and the B timebase board. From the functional point of view, the module may be considered board by board, with the addition of display switching.

Display Switching (Fig. 17)

Signals to the X amplifier and to the X plates in the c.r.t. are controlled by the four position DISPLAY switch. The following display modes are obtained:-

- (1) EXT : External X signals are fed via a cathode follower and an X amplifier on the A timebase. Bright-up is set to a pre-determined level.
- (2) A SWEEP : Only the A timebase is operative controlled by trigger circuits.
- (3) B INT BY A : The B timebase is controlled by the trigger circuits, and drives the X plates via the X amplifier on the A timebase. A delayed trigger from the B timebase fires the A timebase. The A timebase gate signal is mixed with the B timebase bright-up to provide a B display intensified for the duration of the A timebase.
- (4) A DELAYED BY B : Normal operation of the A timebase is delayed by the B timebase as above, and the A timebase drives the c.r.t.

Trigger and Auto Logic (Fig. 6)

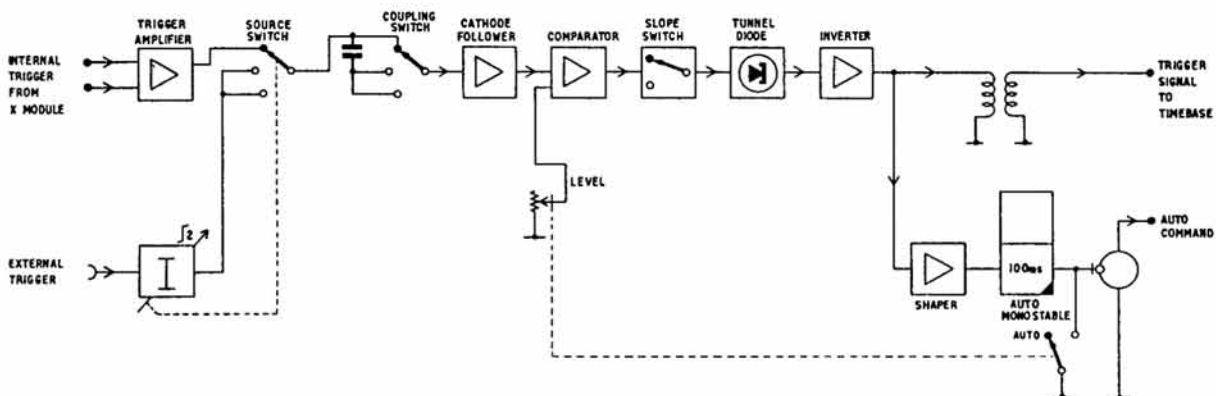


Fig. 6. Trigger Board - Block Diagram

The trigger signal applied to the trigger card may be derived from either the Y module or an external source. Signals from the Y module are fed to the trigger source switch via a differential amplifier. The switch selects either internal, external or external - 20 trigger.

The selected trigger signal is fed via a coupling switch (DC ext. only, a.c. or a.c. fast) and a cathode follower to a comparator where the signal is compared with a d.c. potential from the level control. A slope switch selects either positive or negative triggering from the comparator. When + is selected, a fast, negative going step from a tunnel diode is applied via an inverter and a pulse transformer to the timebase. When - is selected, the tunnel diode is driven by the opposite phase of the comparator output. The step is now timed from the negative edge of the input signal. When the SYNC position of the slope switch is selected, a trigger pulse is derived at an exact sub-multiple of the input signal frequency; this position is used to lock to sinusoidal waveforms at frequencies above 20MHz.

In the absence of any trigger signal, the auto logic function enables the timebase to free run. Normally, the sweep generator will only function on receipt of a trigger signal which enables the ramp control bistable to operate and hence start a sweep. When AUTO is selected, a bias is applied to the ramp control bistable in place of the trigger signal via the auto gate and the schmitt level detector. This is sufficient to operate the ramp control bistable and thus cause the timebase to free run, independently from the trigger.

In the presence of a trigger signal, the auto logic function removes the bias from the ramp control bistable and allows the timebase to be triggered normally. The trigger signal is fed via a shaper to a monostable with a quasi-stable period of 100ms. During this period, an inhibit is applied to the auto gate which removes the bias at the ramp control bistable. If a trigger pulse is received during the 100ms period, it is passed to the ramp control bistable which changes state, and fires the timebase. If no trigger pulse is received within the 100ms period, the monostable reverts to its original state and the inhibit is re-applied to the auto gate which then overrides the ramp control bistable so that the timebase free runs. Trigger pulses arriving during the 100ms period are ignored by the monostable until the end of the period when it changes state. The next trigger fires the monostable for a further 100ms but the auto gate inhibit is maintained due to the integration of the change of state.

A Timebase and X Amplifier (Fig. 7)

When a trigger pulse is received from the trigger card or the B timebase, the ramp control bistable is set and the inhibit at the ramp input gate removed; the selected timing capacitor in the generator starts charging. Bootstrap action maintains the linearity of the resultant waveform which is fed to:-

- (1) A switched X amplifier and the final X amplifier in the display unit.
- (2) A hold off network and a buffer to the schmitt level detector.
- (3) The rear panel as the A RAMP signal.

When the ramp waveform reaches a preset level, the level detector resets the ramp control bistable which applies an inhibit to the ramp control gate. The timing capacitor in the ramp generator discharges and the ramp waveform falls to its mini-

mum level. The hold-off delay, switched in conjunction with the selected ramp, enables the circuits to settle before the next ramp commences.

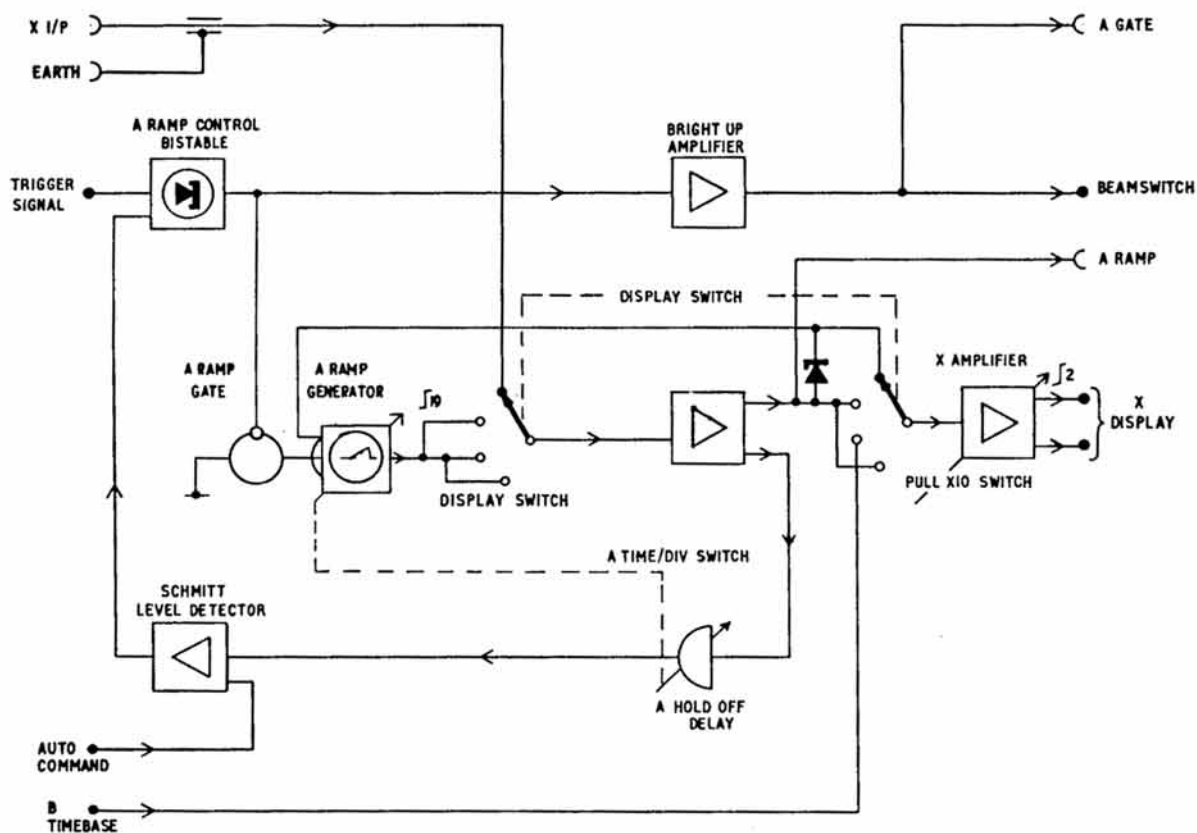


Fig. 7. A Timebase and X Amplifier - Block Diagram

The bright-up amplifier produces a square wave coincident with the ramp. The amplifier is driven from the ramp control bistable and the output is fed to the rear panel as the A GATE signal to the beamswitch in module 1Y2 and as bright-up via the DISPLAY switch.

When EXT is selected, the ramp generator is disabled and the X amplifier fed from an externally applied signal. The level is shifted to move the zero point of the display to the centre of the c.r.t. In the A SWEEP mode, the A timebase functions normally and the B timebase is inoperative. In the B INT BY A mode, the X amplifier is driven by the B timebase. A delayed trigger signal from the B timebase drives the A timebase ramp generator which provides the A GATE signal. This A GATE signal is mixed with the B timebase bright up. In the A DELAYED BY B mode, the A timebase is fired by a delayed trigger from the B timebase.

B Timebase (Fig. 8)

The operation of the B timebase is similar to that of the A timebase. When a trigger pulse is received from the trigger card, the ramp control bistable is set

and the inhibit at the ramp input gate is removed; the selected timing capacitor in the generator starts charging. The resultant waveform is fed to :-

- (1) The X amplifiers in the A timebase via the DISPLAY switch.
- (2) The level detector via a hold-off network.
- (3) A delay time comparator and a delay time bistable which provides the delay trigger signal for the A timebase.

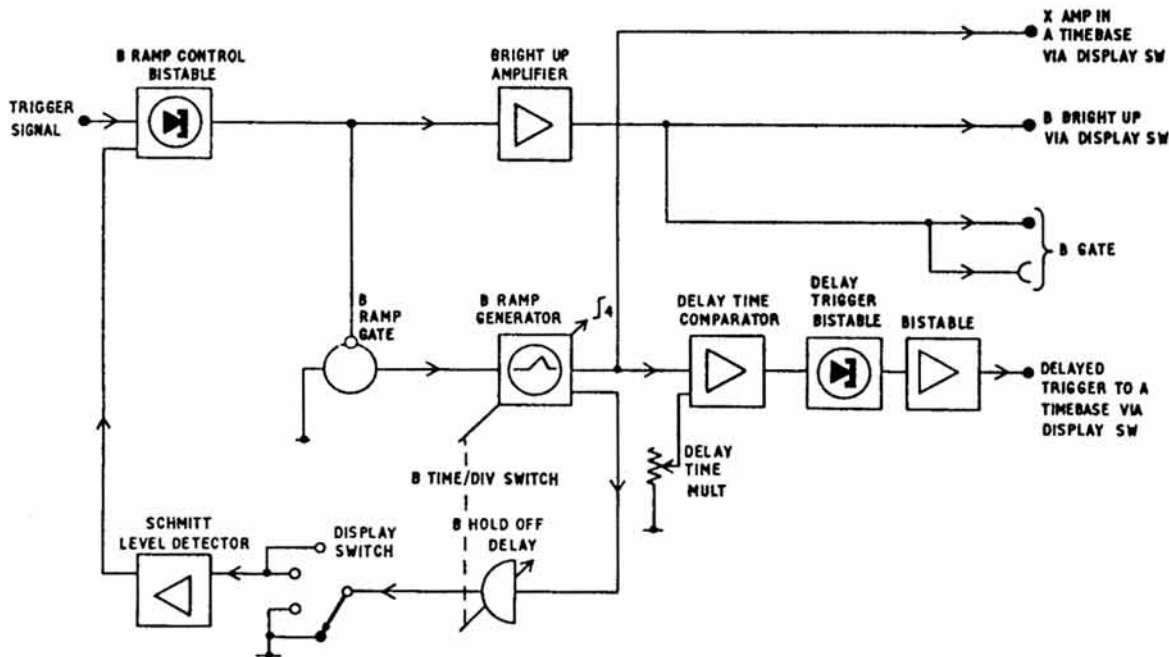


Fig. 8. B Timebase - Block Diagram

When the ramp waveform reaches a preset level, the output from the level detector resets the ramp control bistable which inhibits the ramp input gate. The timing capacitor in the ramp generator discharges and the ramp waveform falls to its minimum level. The hold-off delay, switched in conjunction with the selected ramp, enables the circuits to settle before the next ramp commences.

The bright-up amplifier produces a square wave coincident with the start and finish of the ramp signal. The amplifier is driven from the ramp control bistable and the output is fed externally as the B GATE and B bright-up signal.

The delay time comparator is fed with the ramp waveform from timebase B. This is compared with a d.c. level set by the DELAY TIME MULT potentiometer which sets the delay period in conjunction with the B TIME/DIV control. When the ramp exceeds the selected d.c. level, the comparator turns on the delay trigger bistable which feeds a trigger pulse to the ramp control bistable in the A timebase.

4.2 CIRCUIT DESCRIPTION

Trigger Amplifier (Fig. 11)

The trigger inputs to the differential amplifier 1VT1, 1VT2, are fed from the Y module via the display unit. The single-ended output is passed via 1D1 to the base of 1VT3; the d.c. level is set by 1RV1, and the bias for 1VT3 is held constant by zener diode 1D2. The output from 1VT3 is fed to the source switch SA which selects the sweep triggering signal. External trigger signals may be applied at EXT TRIG SKT1 via R19 and selected by switch SA as either EXT - 20 via divider resistors R15 and R16 or EXT.

The trigger signal is connected to the cathode follower 1V1 via a coupling switch SB which couples directly (DC EXT ONLY) or via C14 or C15 (AC, ACF). The cathode follower 1V1 is protected by diodes 1D3, 1D4, capacitor 1C7 and resistor 1R17. A cathode follower is used to obtain an input impedance of one megohm. The output from the cathode of 1V1 is fed to the base of 1VT4 which with 1VT5 forms a long-tailed pair. The other input to the long-tailed pair is a d.c. level set by RV1 (LEVEL). By the arrangement of resistors 1R23, 1R24, 1R25 the base of 1VT5 is at the same potential as the cathode of 1V1 (+1V approx.), when the slider of RV1 is midway. This condition is set by 1RV4.

Slope switch SC selects either positive or negative triggering. High frequency synchronisation (SYNC) can also be selected by this switch. In the negative (-) position of SC, diodes 1D10 and 1D8 are on and diodes 1D11 and 1D6 are off. A negative change applied to the base of 1VT4 tends to cut it off and increase the current in 1VT5. This increase in current flows from the collector of 1VT5 through diode 1D8, resistor 1R41, and tunnel diode 1D7 in parallel with inductance 1L1 and resistor 1R48. The resistance of 1R48 is high compared with the resistance of the tunnel diode, and the increase in current in the tunnel diode causes it to switch to its "high" state, producing a very fast negative going change of voltage at the base of amplifier 1VT6. Inductance 1L1 prevents this fast change being lost via resistor 1R48. The trigger signal is inverted and differentiated by transistor 1VT6 and inverted again by transformer 1T1 in the collector of 1VT6. Any positive excursion of the waveform is taken off by diode 1D5 before the negative-going signal is fed via switch SF (Fig. 17) to the timebases.

When SC is in the positive (+) position, diodes 1D11 and 1D6 are on and diodes 1D10 and 1D8 are off. A positive change applied to the base of 1VT4 causes a change of current through the tunnel diode and the circuit operation is the same as for the negative position of the switch.

In the SYNC position of SC, the tunnel diode is connected as an oscillator which runs continuously at a frequency of approximately 2MHz, the frequency being varied by the LEVEL control RV1 to be near a sub-multiple of the input frequency. The oscillator will then "lock on" to the input signal.

Auto Logic Circuit

The auto logic circuit is used to obtain a display when the oscilloscope is being used to monitor a waveform of unknown parameters.

The circuit is fed from transistor 1VT6 via amplifier 1VT10 and comprises a monostable 1VT7 and 1VT8 with a recovery time of 100ms controlling the A timebase via transistor 1VT9. The circuit is controlled by switch SD (ganged to H.F. STAB control). With SD open, i.e. AUTO selected, and no trigger pulse from 1VT10, 1VT7 is on and 1VT8 is off. Base current in 1R37 holds 1VT9 in a conducting state, drawing current via 1R68 in the A timebase (Fig. 13). This causes the timebase to free run, producing a display on the c.r.t.

When a trigger pulse arrives via 1VT10, the monostable changes state, switching diode 1D9 on and cutting off 1VT9. The timebase is then triggered normally via transformer 1T1 and pins 52 and 53. The astable stays in this state for 100ms. If the trigger pulses recur with an interval less than 100ms the astable output is integrated by 1R36 and 1C15 so that 1VT9 stays off. When the trigger pulses stop, the A timebase is again caused to free run.

Timebase A (Fig. 13)

Timebase A consists of a gate circuit, bootstrap ramp generator, hold-off circuit, and an amplifier.

The input pulse from the trigger board is fed via switch SF (Fig. 17) to the A timebase gate 2D5 via pins 72 and 73. This gate is also under the control of the hold-off schmitt trigger circuit 2VT4, 2VT5. The tunnel diode gate 2D5 is set to its "high" voltage condition by the trigger input signal. This action cuts off transistor 2VT7, and the timing capacitor, which is selected by switch SE, commences to charge via the timing resistor. Cathode follower 2V1, which is fed by a constant current generator 2VT8 feeds emitter follower 2VT9 which routes the ramp waveform in two directions.

The timing capacitor is charged from the cathode follower 2V1 via emitter follower 2VT10, which is fed in its base circuit from the slider of the fine velocity control RV3 (VAR). The calibration of the timebase velocity is set by 2RV3 to give approximately 10V across the timing resistor. The ramp waveform is also fed from the emitter follower 2VT9 via emitter follower 2VT6 to the schmitt trigger 2VT4, 2VT5. When the ramp reaches the pre-determined length set by 2RV2, the schmitt changes state, and the tunnel diode 2D5 becomes reverse biased through 2R12, switching on 2VT7. This discharges the timing capacitor and the ramp waveform falls rapidly to within a few millivolts of 0V. This ramp waveform appears across the chain of diodes 2D10, 2D11, 2D12 and is fed from the junction of zener diodes 2D10 and 2D11 when switch SF is in the EXT position, and from the junction of 2D11 and 2D12 when the switch is in any other position. Zener diode 2D11 adds 5.6V to move the zero point of the signal into the centre of the c.r.t. when EXT is selected by SF.

To prevent another ramp waveform commencing before all the circuits have settled down, a hold-off circuit is incorporated utilizing one of the timing capacitors not in use, to delay the reset of the schmitt trigger. When the ramp waveform falls, the hold-off capacitor discharges via 2R69 and the H.F. STAB control RV2. Emitter follower 2VT6 buffers the hold-off circuit from the schmitt trigger. The trigger resets when the hold-off voltage reaches a pre-determined value.

The output stage consists of long-tailed pair 2VT11 and 2VT12 feeding emitter-followers 2VT13 and 2VT14. The gain of this stage is controlled by a two position switch 2SA (PULL X10). This switch is arranged to magnify the display by ten. Preset resistors 2RV4 and 2RV5 are used to set up the stage gain for the two positions of 2SA. Diodes 2D15 and 2D16 provide reverse bias protection for 2VT11 and 2VT12 respectively. A low impedance source for the base of 2VT12 is provided by emitter-follower 2VT15, which is fed from a potentiometer 2RV6 (X SHIFT) across the supply. The output of this module is matched to the main frame input by means of SET CAL potentiometer 2RV7.

The bright-up circuit consisting of 2VT2, 2VT3 and 2VT16 provides an input to the bright-up amplifier on the display unit. The timing of this pulse is derived from the tunnel diode circuit via resistor 2R4 and fed to the base of transistor 2VT2. The voltage at the collector of 2VT2 rises at the start of the ramp towards +15V but is caught at +6V by diode 2D2, and the resultant square wave is fed to 2VT3 via the compensating circuit 2C2 and 2R5. 2RV1 in the base of 2VT3 sets the amplitude of the bright-up current which is fed from the collector, via 2R67 and switch SF to the main frame. The bright-up current through 2R67 produces a 2V gate pulse which is fed to the beamswitch in the Y module via emitter follower 2VT16.

Regulator 2VT1, which is in series with the +30V d.c. supply and the valve heaters has a reference voltage applied to its base from 2D1. It provides 6.3V d.c. across the heaters of valves 1V2, 2V2, 3V1.

Timebase B (Fig. 15)

The B timebase, which is almost identical in operation to the A timebase, can be used to produce the X ramp waveform or to produce a delayed trigger pulse for the A timebase.

A bootstrap ramp generator is used, with the timing components selected by switch SH. The emitter follower feeding the timing capacitor is part A of the double transistor 3VT9. A double transistor is used to obtain good thermal stability. The B side of this transistor is used as a diode in series with zener diode 3D10, which sets the charging potential to nominally 10V across the timing resistor R14. The constant current generator 3VT8 has a reference fed to the base from transistor 2VT8 in the A timebase. Preset controls 3RV6 and 3RV3 set the range of RV4, the VAR control to 5 : 1. Preset resistor 3RV2 in the emitter of 3VT9 is a length control. The ramp waveform is fed out at pin 12 via switch SF to the output amplifier of the A timebase.

The double transistor 3VT11 functions as a comparator, base A being fed with the ramp waveform. Base B is fed with a d.c. voltage from RV5 DELAY TIME MULT. Diodes 3D13 and 3D14 are reverse bias protection for 3VT11 A and B. The A transistor is normally conducting. When the ramp waveform goes more positive than the d.c. level from RV5, the B side of 3VT11 conducts, firing the tunnel diode 3D15. The pulses fed via emitter follower 3VT14 are differentiated by 3C17 and 3R55 and applied via switch SF in the appropriate position to tunnel diode 2D5 in the A timebase.

The hold-off circuit functions the same as for the A timebase, the hold-off capacitor being switched by switch SH. The discharge path for this capacitor is via 3RV42 and the H.F. STAB control RV2 in the A timebase. In the EXT and A SWEEP positions of switch SF the hold-off capacitor is earthed via 3D9.

The action of the bright-up circuit is the same as for the A timebase. An output is taken from 2VT3 to the bright-up amplifier in the display unit, and a gate output is taken from emitter-follower 3VT16, via SF to the beamswitch in the Y module. The amplitude of the bright-up pulse is adjusted by 3RV1.

DISPLAY Switch SF (Fig. 17)

When DISPLAY switch SF is in the EXT position, the external signal is applied to the cathode follower 2V1 in timebase A, and from there to the c.r.t. via the X amplifiers. The A and B timebases are inoperative. Bright-up is obtained by feeding the main frame bright-up amplifier from the -15V supply via R11.

In the A SWEEP position the A timebase receives trigger pulses from the trigger board, and produces a ramp waveform which is fed to the main frame X amplifier; a bright-up pulse which is also fed to the main frame, and a gate signal which is fed to the beamswitch in the Y module. The B timebase bright-up pulse is terminated in resistor R12.

With B INT BY A selected, the B timebase receives trigger pulses from the trigger board and produces a ramp waveform which is fed via X amplifier to the c.r.t., a bright-up pulse, and a gate signal which is fed to the beamswitch in the Y module. The A timebase is fed with a delayed trigger pulse from the B timebase. The A bright-up is terminated in R12. The A gate is mixed with the B bright-up pulse in R18 and 6R3 on the main frame to produce a bright-up signal consisting of 60% B and 40% A.

In the A DELAYED BY B position the A trigger pulse is again fed from the B timebase where it is delayed. The A timebase produces a ramp waveform, the bright-up pulse, and a gate signal for the Y module. The B bright-up is terminated in R12.

5. MAINTENANCE

5.1 MECHANICAL FEATURES

Removal of Module from Display Unit

Unscrew the slotted thumbscrew on the front and give the module a sharp pull forwards with the left hand while holding the display unit with the right. This will disengage the connectors, and the module will then slide smoothly off in a forwards direction. To replace the module, engage the rails on the frame with the guides on the chassis and slide the module on until the retaining screw engages, then tighten the screw.

Removal of Cover

The module cover may be removed by unscrewing the four plated screws on the outer face of the cover.

Access to Trigger Board

Access to components on the trigger board is facilitated by partially removing the board with the upper horizontal tie bar from the chassis.

- (1) Remove the screw from each end of the upper horizontal tie bar.
- (2) Remove the screw from the upper end of the vertical tie bar.
- (3) Carefully slide the sub-assembly (including the board) away from the chassis.

NOTE: For complete removal, it is necessary to unplug the Amp pin from the board and remove the three screens holding the board to board brackets. If, during maintenance checking, the module is used with the trigger board removed, ensure that good Amp pin connection is constantly maintained.

- (4) Assembly is the reverse procedure to removal. Locate the sub-assembly on to chassis. Secure at the front with a chrome, mushroom head screw. Secure at the rear with a cheese head screw and star washers. Secure to the top of the vertical tie bar with a countersunk head screw.

Access to 'A' TIME/DIV Switch

Access to components on the 'A' TIME/DIV switch is achieved by removing the switch from the chassis.

- (1) Remove the two knobs from the switch by slackening two grub screws on each knob.
- (2) Remove the two screws and nuts from the outer face of the vertical tie bar.

- (3) Unplug the Amp pins from the amplifier board associated with the 'A' TIME/DIV switch (pins 7, 27, 32, 33, 34, 35, 36).
- (4) Remove the switch.
- (5) Assembly is the reverse procedure to removal.

Access to 'B' TIME/DIV switch and 'B' VAR potentiometer

Access to components on the 'B' TIME/DIV switch is achieved by easing the switch assembly away from the chassis.

- (1) Remove the two knobs from the 'B' TIME/DIV switch by slackening two grub screws on each knob.
- (2) Remove three nuts with bolts securing the 'B' TIME/DIV switch assembly (including bracket) to the chassis and 'A' timebase board.
- (3) To gain access to components at the back of the switch, slacken off the switch nut and carefully rotate the switch as required.
- (4) To change the 'B' timebase VAR potentiometer (RV4), unsolder the leads to the potentiometer. Remove nuts and washers securing the potentiometer plate to the switch. Lift assembly away from the chassis and pull the potentiometer assembly away from the shaft. Change the potentiometer and refit potentiometer assembly to switch.
- (5) Assembly is the reverse procedure to removal.

Fitting of PULL X10 Switch 2SA

If the 'A' timebase board is removed and refitted, care must be taken when connecting the PULL X10 switch 2SA to the coupling rod. Failure to adopt the correct procedure may place excessive strain on the timebase board at the switch location. Always ensure that the bend in the PULL X10 shaft is hard up against the back end of the DISPLAY switch shaft when the switch is in the X10 position. To achieve this, set switch 2SA to the PULL X10 position, remove the DISPLAY knob, loosen the two grub screws securing the DISPLAY shaft to the slotted coupling rod and position the DISPLAY shaft against the bend in the PULL X10 shaft. Secure the coupling rod to the DISPLAY shaft and fit the DISPLAY knob. When the switch is in the x1 position (pushed in), the rear face of the knob must be hard up against the front face of the DISPLAY knob on the front panel.

Replacement of DELAY TIME MULT potentiometer RV5

- (1) Remove knob, using small allen key to slacken off grub screw.
- (2) Unsolder leads at rear of potentiometer.
- (3) Unscrew the centre slotted ring using round nose pliers.

- (4) Remove potentiometer from front panel.
- (5) Locate replacement potentiometer in front panel.
- (6) Fit bezel assembly and secure with slotted ring, ensuring that the engraved line on the centre bezel is at the 12 o'clock position.
- (7) Turn shaft fully counter clockwise.
- (8) Locate knob on shaft so that pip engages with appropriate slot.
- (9) Turn the knob counter clockwise until the '0' on the knob and the outer bezel are aligned with the engraved line on the centre bezel.
- (10) Secure the knob to the shaft using allen key.
- (11) Check that rotation of knob is unimpeded. Solder leads to potentiometer.

AMP Connectors

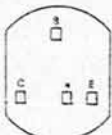
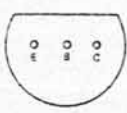
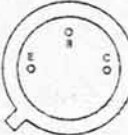
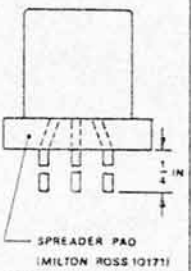
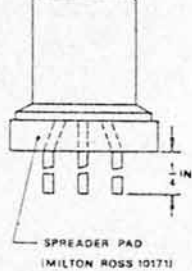
On some units connections to the circuit boards are made via AMP type pin connectors. It is essential that when removing or inserting these connectors, the following precautions are observed:-

- (1) Remove AMP pins by firmly grasping the crimped portion of the socket with a pair of square nosed or duck billed pliers and pulling the socket with an even pressure along the axis of the pin.
- (2) Fit AMP pins by firmly grasping the crimped portion of the socket with square nosed or duck billed pliers and pushing the socket squarely on to the pin with even pressure.
- (3) Making 'unsquare' connections can tend to open out the socket and result in a poor connection. This may cause intermittent operation affecting the performance of the instrument.
- (4) Any reconnections showing signs of looseness must be remade after the socket has been sufficiently closed up.

Plug-in Semiconductors

Transistors and tunnel diodes mounted on the boards are of the plug-in type. When renewing plug-in semiconductors, the leads must be trimmed as specified in Table 4.

TABLE 4. PLUG-IN SEMICONDUCTOR INFORMATION

SOCKET CONNECTIONS	TO-92 PLASTIC PACKAGE	TO-18 METAL CASE PACKAGE
	VIEW ON LEADS	
 VIEWED FROM COMPONENT SIDE OF PRINTED CIRCUIT BOARD		
	TRIMMING LEADS	
* NOT USED		

5.2 SETTING-UP INSTRUCTIONS

All internal potentiometers are set up at the factory, and should not be disturbed unless components are replaced or there is a definite indication that the unit is functioning incorrectly. Should this be the case the relevant potentiometer(s) should be set to the mid-position and then reset according to the following instructions, which constitute a complete performance check. Individual checks may, of course, be performed if required.

Equipment Required

- (1) Multimeter. AVO 8 or similar.
- (2) Dynamco 71 series 10KV display unit (calibrated).
- (3) Dynamco 71 series Y-module (calibrated).
- (4) Display unit to module extension leads. (Dynamco 7148).
- (5) Calibrator signal divider unit. (See Fig. 9).
- (6) Time marker generator producing sinewave or pulse from 1s to 20ns $\pm 1\%$ e.g. Tektronix 184.
- (7) Compensated 10 : 1 probe.
- (8) BNC T-junction e.g. Greenpar Eng. Co. GE35031.

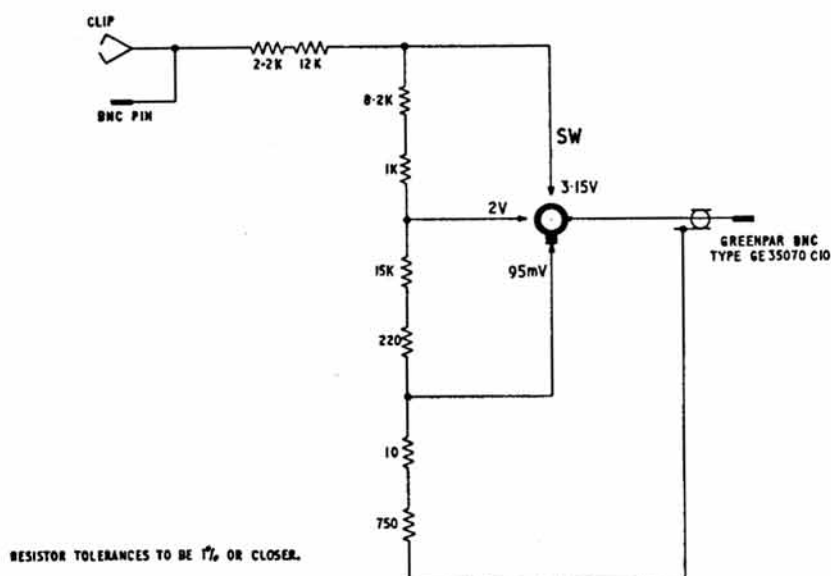


Fig. 9. Calibrator Signal Divider Unit

Supplies Check

- (1) If preset potentiometer 2RV1 has been replaced or disturbed set it fully counter-clockwise.
- (2) With the multimeter (item 1) negative lead to chassis and the module unplugged from the display unit, measure the resistance of all power rails. Verify that the resistances are as specified in Table 5.

TABLE 5. SUPPLY RAIL RESISTANCE

Supply Rail	PLA Pin No.	Resistance
+117V rail	1	Approximately 7K
+30V rail	3	Approximately 5.5K
+15V rail	5	Approximately 1.2K
-15V rail	9	Approximately 400
6.3V a.c.	8	O/C

- (3) Fit the 1X2 module to the display unit with a Y-module using the 1 : 1 extension leads (item 4).

- (4) Set the front panel controls as follows :-

1Y1/2		1X2	
Mode (1Y2 only) :	CH1	INT, EXT, EXT - 20 :	EXT
Trig (1Y2 only) :	CH1	DC, AC, ACF :	AC
AC, DC, GND :	AC	SYNC, +, - :	+
VOLTS/DIV :	1.0	LEVEL :	midway
		H.F. STAB :	midway
		TIME/DIV :	200 μ s
		VAR :	CAL
		DISPLAY :	EXT
		SHIFT :	midway
		PULL X10 :	X1

- (5) Switch on, allow 15 minutes warm up and using the multimeter, check that the supply rail voltages are as detailed in Table 6.

TABLE 6. SUPPLY RAIL VOLTAGES

A Timebase board Pin No.	Voltage
8	+117 $\pm$ 3V
29	+15 $\pm$ 0.3V
11	+15 $\pm$ 0.3V

Nuvistor Heater Supplies

Check that the voltage between P18 and chassis is between +18V and +20V.
Check that the voltage between P2 and chassis is between +6V and +6.6V.

Set Calibration

- (1) Feed 5V peak-to-peak from the calibrator to the X I/P socket at the rear of the module via a 0.1 μ F capacitor.
- (2) Adjust SET CAL fully clockwise and note the line length.
- (3) Adjust SET CAL fully counter-clockwise and note the line length.
- (4) Adjust SET CAL to the mean value of (2) and (3).

X Amplifier x1 Gain

With 5V still applied to the X I/P socket, adjust 2RV5 for a 5 division display.

Trigger Polarity

- (1) Set the DISPLAY switch to A SWEEP
- (2) Clip the calibrator signal divider unit (item 5) to the calibration loop on the display unit. Feed 5V from the loop to the Y amplifier CH1 input using the BNC pin lead.
- (3) Set the divider unit to 2V and connect the BNC plug to the EXT TRIG socket on the 1X2 module.
- (4) Adjust the X shift control so that the start of the trace is visible. Turn the level control clockwise and check that 1X2 triggers from a positive edge.
- (5) Set trigger slope switch to - and check that 1X2 triggers from a negative edge.

EXT $\div$ 20 Mode

Set the trigger source switch to EXT - 20. Check that reliable stable triggering is obtained using the LEVEL control.

EXT Triggering Sensitivity

Set the trigger source switch to EXT, and set the calibrator divider unit to 95mV output. Check for reliable stable triggering on both polarities of the source switch using the LEVEL control as necessary.

EXT Trigger Level

- (1) Switch the calibrator divider unit to 3.15V output.
- (2) Using the LEVEL control, check that the timebase triggers over the whole of the leading edge of the waveform, but stops triggering when the window exceeds the ends of the leading edge.

Auto Triggering Sensitivity

- (1) Check that the trigger coupling switch is at A.C. Set 1X2 TIME/DIV control to 1ms/div.
- (2) Switch to AUTO and set the LEVEL control exactly midway.
- (3) Switch the calibrator divider unit to 95mV output.
- (4) Set trigger slope switch to +.
- (5) Readjust LEVEL control until the trace is locked. Ensure that the new angular position of the control is within 5° of its original position.

- (6) Adjust 1RV4 so that the angular position is balanced $\pm 2.5^0$ about the midway position.

NOTE: Ideally 1RV4 is adjusted to achieve a locked display without rotating the LEVEL control from its midway position when the trigger slope switch is changed from + to -.

Level Sense

- (1) Set the trigger coupling switch to DC and set the calibrator divider unit to 2V output.
- (2) Ensure that the timebase will trigger when the LEVEL control is between midway and clockwise of midway but not when counter-clockwise of midway.

Trigger Amplifier Bias

- (1) Set the trigger slope switch to +, the trigger source switch to INT and the TIME/DIV control to 1ms/div.
- (2) Switch to AUTO, and if a 1Y2 module is in use set the 1Y2 mode switch and the trigger switch to CH1 and set CH1 input to GND.
- (3) Set the Y module BAL control so that no deflection of the trace occurs when the VAR control is rotated.
- (4) Using a multimeter, check that the voltage between pin 41 on the trigger board, and earth is $4.5V \pm 0.2V$ and that the voltage between pins 41 and 42 is less than 50mV.
- (5) With the multimeter on the 2.5V range and connected between pin 56 on the trigger board and earth, adjust 1RV1 for $0V \pm 250mV$.

Trigger Amplifier Sensitivity

- (1) Disconnect the Y module input from the calibrator 5V output and connect it to the variable output of the calibrator unit set to 3.15V.
- (2) If a 1Y2 module is in use, select CH1 on both the mode and trigger switches.
- (3) Set the Y module input switch to AC, VOLTS/DIV to 0.5V and VAR to CAL.
- (4) Set the 1X2 module controls as follows:-

INT, EXT, EXT - 20	:	INT
DC, AC, ACF	:	AC
SYNC, +, -	:	+
TIME/DIV	:	1ms
HF STAB	:	AUTO

- (5) Verify that the display shows 6.3 divisions of deflection.
- (6) Check that the timebase ceases to trigger (shown by free running) when the LEVEL control is turned fully clockwise and fully counter-clockwise.
- (7) Check that a stable display can be obtained using the LEVEL control with the trigger coupling switch in the ACF position.
- (8) Set the calibrator divider unit to 95mV. If a 1Y2 module is in use verify that CH1 is set for 0.5V/div (=0.2 divisions of deflection).
- (9) Set the 1X2 module as follows:-

INT, EXT, EXT - 20	:	INT
DC, AC, ACF	:	AC
SYNC, +, -	:	+
HF STAB	:	AUTO
- (10) Using the LEVEL control verify that a locked display can be obtained in the AUTO and non-AUTO modes of operation.

SYNC Operation

- (1) Switch off the AUTO trigger and set the LEVEL control fully counter-clockwise.
- (2) Set the 1X2 module controls as follows:-

INT, EXT, EXT - 20	:	INT
DC, AC, ACF	:	AC
SYNC, +, -	:	SYNC
TIME/DIV	:	0.2 μ s
PULL X10	:	X10
- (3) Feed 50MHz from the time marker generator (item 6) into the Y module input.
- (4) Adjust Y module for a display of 1.5 to 2 divisions.
- (5) Adjust the LEVEL and HF STAB controls and ensure that a stable trace is obtainable. Reduce the magnification to X1 and disconnect the time marker generator.

'A' Timebase Bright-Up Pulse Amplitude and Compensation

- (1) Set the 1X2 module controls as follows:-

TIME/DIV	:	0.2 μ s
INT, EXT, EXT - 20	:	EXT
HF STAB	:	AUTO

- (2) Adjust the brilliance until the spot at the start of the trace is just visible.
- (3) With the input of the Y module connected to pin 51 on the timebase board by a compensated 10 : 1 probe, adjust 2RV1 for 350mV deflection and 2C2 for optimum square corner.

'A' Timebase Sweep Length and Velocity

- (1) Set the 1X2 module controls as follows :-

TIME/DIV	:	1ms
INT, EXT, EXT - 20	:	INT
SYNC, +, -	:	+

- (2) Feed 1ms markers from the marker generator (item 6) into the Y module input, and adjust the VOLTS/DIV control for 2 divisions deflection.
- (3) Adjust 2RV3 for one marker on each graticule division between the first and ninth graticule lines, and 2RV2 to give a sweep length of 10.5 divisions.

X Amplifier Gain

Set the PULL X10 switch to X10. Set the time marker generator to give 100 μ s markers and adjust 2RV4 for one pulse per division between the first and ninth graticule lines.

X Shift Range

Set the PULL X10 switch to X1 and check that it is possible to centre each end of the trace.

'A' Timebase Range and Calibration

- (1) Set the time marker generator to give 1ms markers.
- (2) Set the 'A' TIME/DIV control to 2ms/div and check that alternate marker pulses are on a graticule division. Maximum deviation between zero and the tenth graticule divisions to be not greater than 0.1 divisions.
- (3) Set the 'A' TIME/DIV control to 0.5ms/div. Check that there is a marker pulse at alternate graticule divisions.
- (4) Adjust the X shift to align the first pulse with the zero graticule line. The maximum deviation between the zero and the tenth graticule lines must not be greater than 0.2 divisions.
- (5) Check that the fine velocity control VAR decreases the sweep speed by at least 2.5 times. Return this control to CAL.

- (6) With the time marker generator set to give 1 pulse in ten divisions, check the 100ms/div., 10ms/div., 100 μ s/div. and 10 μ s/div. ranges.
- (7) With the first pulse aligned with the zero graticule line the second pulse shall not be more than ± 0.2 divisions from the tenth line.
- (8) Switch the TIME/DIV control to 1 μ s/div. and feed in 1 μ s markers from the time marker generator.
- (9) Adjust 3C2 for one pulse per division from the first to the ninth graticule lines.
- (10) Feed a 10MHz sinewave from the time marker generator into the Y module.
- (11) Set the 'A' TIME/DIV control to 0.2 μ s/div. Check for two cycles per division, the error to be not greater than 0.3 divisions.
- (12) Set the PULL X10 switch to X10.
- (13) Feed 50MHz into the Y module from the time marker generator.
- (14) Set the trigger slope switch to SYNC and check for 1 cycle/division with a maximum error of ± 0.5 divisions over 10 divisions. Check that the overall sweep linearity is satisfactory.

Ancillary Outputs

- (1) Return the PULL X10 switch to X1.
- (2) Check at the rear panel sockets for 2V peak-to-peak 'A' gate and 1V peak-to-peak 'A' ramp waveform using the oscilloscope probe.

ALT Pulse Amplitude

With a 1Y2 module in use, switch to ALT and check that all positions of the TIME/DIV controls give alternate sweeps using the 'A' and 'B' gate pulses in turn i.e. DISPLAY switch at A SWEEP for 'A' TIME/DIV controls and at B INT BY A for the B TIME/DIV control. If a 1Y1 module is in use, check at pin 5 of PLB on the 1X2 module for at least 2V peak-to-peak on all positions of both 'A' and 'B' TIME/DIV controls.

'B' Sweep Bright-up Amplitude and Compensation

- (1) Set the 1X2 module controls as follows:-

INT, EXT, EXT - 20	:	EXT
DC, AC, ACF	:	AC
HF STAB	:	midway
SYNC, +, -	:	SYNC
LEVEL	:	approximately 9 o'clock

'A' TIME/DIV	: 0.1ms
'B' TIME/DIV	: 1ms
SHIFT	: midway
DISPLAY	: B INT BY A

- (2) Using the compensated 10 : 1 probe (item 7) connected to the Y module input, monitor the output of the bright-up circuit at pin 15 and increase brilliance until the spot at the start of the trace is just visible.
- (3) Adjust 3RV1 for a 220mV pulse on pin 15, ignoring the intensified portion of the trace (see Fig. 10).
- (4) Adjust 3C2 for optimum square corner on the leading edge.

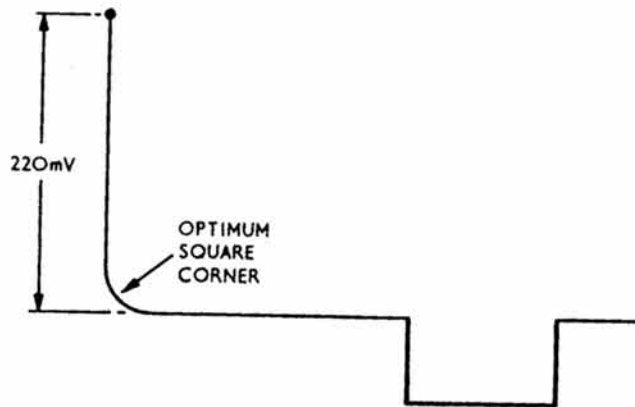


Fig. 10. 'B' Bright-Up

'B' Sweep Length and Velocity

- (1) Apply 1ms markers from the time marker generator to the Y module input and adjust the control for a 2-3 division display.
- (2) Adjust 2RV3 for 1 pulse/division between the first and ninth graticule lines and 3RV2 for 10.5 division trace length.

'B' Timebase Range Check

Check the TIME/DIV positions with relevant markers at 1 pulse/divisions. With the first pulse on the zero graticule line, the second pulse must be on the tenth graticule line, the error to be not more than ± 0.3 divisions.

'B' Timebase Fine Velocity Range

- (1) Return the 'B' TIME/DIV control to 1ms/div. and inject 10ms markers into the Y module input.
- (2) Turn the 'B' VARIABLE TIME/DIV control fully counter-clockwise and adjust 3RV6 for 2 divisions per pulse between the first and tenth graticule lines. Return 'B' VAR to CAL.

- (3) Set the time marker generator to 1ms markers. Re-adjust 3RV3 for 1 marker per division between the first and ninth graticule lines.
- (4) Repeat (1), (2) and (3) until no further adjustments are necessary.

Delay Time Multiplier Range Adjustment

- (1) Check that the 'B' timebase VAR TIME/DIV control is at CAL. Select B INT BY A on the DISPLAY switch and feed 1ms markers from the time marker generator to the Y module input.
- (2) Set DELAY TIME MULT to 1.00. Adjust 3RV4 so that the start of the intensified part of the trace is in line with the first marker.
- (3) Set DELAY TIME MULT to 9.00 and adjust 3RV5 so that the start of the bright part of the trace is in line with the marker.
- (4) Repeat (1) and (2) until the first and ninth pulses are aligned with the bright portion of the trace.

Jitter Check

- (1) Select A DELAYED BY B on the DISPLAY switch and adjust DELAY TIME MULT so that the leading edge of the first pulse is just displayed on the screen.
- (2) Increase the 'A' timebase TIME/DIV control to 1 μ s/division adjusting DELAY TIME MULT to keep the first pulse on the screen.
- (3) Check that any jitter does not exceed one division on the X axis, ignore slow drift.
- (4) Repeat (1) to (3) at the ninth pulse, (i.e. varying DELAY TIME MULT to display the ninth pulse).

Ancillary Check

Check that 'B' gate output at the rear panel of 1X2 for 2V peak-to-peak.

6. PARTS LIST

6.1 GENERAL

The following list includes all replacement parts. When ordering, please quote the TYPE and SERIAL NUMBER of the instrument, together with the CIRCUIT REFERENCE of the part and the relevant SUB-ASSEMBLY.

DMS numbers given for semi-conductor components refer to standards defined by Dynamco Limited to ensure that only those equivalent components are used which enable the specified performance of the instrument to be achieved.

6.2 FRAME COMPONENTS

<u>Circuit Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
RESISTORS					
R1	100K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R2	1M	±1%		Spiral Carbon	Welwyn C2114
R3	19.6K	±1%		Spiral Carbon	Welwyn C2114
R4	100K	±1%		Spiral Carbon	Welwyn C2114
R5	50K	±1%		Spiral Carbon	Welwyn C2114
R6	200K	±1%		Spiral Carbon	Welwyn C2114
R7, R8	500K	±1%		Spiral Carbon	Welwyn C2114
R9	1M	±1%		Spiral Carbon	Welwyn C2114
R10	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R11	2.2K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R12	47	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R13	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R14	100K	±1%		Spiral Carbon	Welwyn C2114
R15	950K	±1%		Spiral Carbon	Welwyn C2114
R16	50K	±1%		Spiral Carbon	Welwyn C2114
R17	100K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R18	820	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R19	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R20 to R23	Not used				
R24	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R25	82K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
VARIABLE RESISTORS					
RV1	10K			Linear	A. B. Metals D47S
RV2	25K			Linear	A. B. Metals D47S
RV3, RV4	2.5K			Linear	Morganite U
RV5	2K	±5%		Linear to 1%	Reliance HEL 07-10

Circuit Ref.	Value	Tol.	Rating	Type	Style
CAPACITORS					
C1	0.022	±10%	250V	Min. met. foil	Mullard C281AB/A22K
C2	7-35p			Ceramic	Steatite 7S Triko 02
C3	0.001	)			
C4	0.01	)			
C5	0.1	)			
C6	1	)			
C7	0.001	)	Matched sets to drawing no. A108 0334		
C8	0.01	)			
C9	0.1	)			
C10	1	)			
C11	22p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/22
C12	4.7p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/4.7p
C13	47p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/47p
C14	0.022	±10%	400V	Film & Foil	Wima Tropyfol F
C15	220p	±10%	400V	Film & Foil	Wima Tropyfol F
C16	Not used				
C17	0.001	±10%	400V	Film & Foil	Wima Tropyfol F

MISCELLANEOUS

PLA, PLB Plug, fixed, 12-pole	McMurdo XP12
SA, SB, SC Switch, lever, 3-way	NSF MLA 4
SD Switch, rotary, 2-way, ganged with RV2	
SE Switch, rotary, to drawing no. 103 0471	
SF Switch, rotary, to drawing no. B103 0472	
SH Switch, rotary, to drawing no. 103 0470	
SKT1 Socket, fixed, co-axial, BNC	Greenpar GE35066
SKT2 to SKT6 Socket, fixed, 2mm	Belling & Lee L1413

6.3 TRIGGER BOARD

NOTE: All components on this board are pre-fixed "1" on the circuit diagram Fig. 11.

Complete printed circuit board assembly Dynamco 105 0193/3B

RESISTORS

R1	1K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R2	1.8K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R3	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R4	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R5	330	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R6	1.8K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R7	Not used				
R8	15K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R9	1K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309

<u>Circuit</u> <u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
R10	3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R11	1.5K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R12	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R13 to R15	Not used				
R16	1M	±1%		Spiral Carbon	Welwyn C2114
R17	100K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R18	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R19	2.7K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R20	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R21	1.5K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R22	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R23	2.7K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R24	330	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R25	2.2K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R26	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R27	1.8K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R28	Not used				
R29	2.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R30	100K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R31	6.8K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R32	2.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R33	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R34	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R35	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R36	1K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R37	100K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R38	270	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R39	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R40	1.2K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R41, R42	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R43	33K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R44, R45	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R46	Not used				
R47	27	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R48	100	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R49, R50	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R51	Not used				
R52	10	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R53	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R54	470K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R55	1K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.

VARIABLE RESISTORS

RV1	10K	Linear	Davall 80P
RV2, RV3	Not used		
RV4	2.5K	Linear	Davall 80P

<u>Circuit</u> <u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
CAPACITORS					
C1	50		25V	Electrolytic	Mullard C426CB/F50
C2	Not used				
C3	50		25V	Electrolytic	Mullard C426CB/F50
C4 to C6	Not used				
C7	0.001	±10%	400V	Film & Foil	Wima Tropyfol F
C8, C9	0.1	±20%	250V	Min. met. film	Mullard C280AE/P100K
C10	330p	±10%	400V	Film & Foil	Wima Tropyfol F
C11	0.1	±20%	250V	Min. met. film	Mullard C280AE/P100K
C12	220p	±10%	400V	Film & Foil	Wima Tropyfol F
C13	4		40V	Electrolytic	Mullard C426AR/G4
C14	100		6.4V	Electrolytic	Mullard C426CB/100
C15	4		40V	Electrolytic	Mullard C426AR/G4
C16, C17	0.1	±20%	250V	Min. met. film	Mullard C280AE/P100K
C18	0.01	±20%	250V	Min. met. film	Mullard C280AE/P10K
C19	220p	±10%	400V	Film & Foil	Wima Tropyfol F
C20	0.1	±20%	250V	Min. met. film	Mullard C280AE/P100K
C21	220p	±10%	400V	Film & Foil	Wima Tropyfol F

TRANSISTORS

VT1, VT2	DMS 84
VT3	DMS 85
VT4, VT5	DMS 95
VT6	DMS 84
VT7 to VT10	DMS 95

DIODES

D1, D2	Zener	DMS 46
D3, D4		DMS 92
D5		DMS 123
D6		DMS 92
D7	Tunnel	DMS 87
D8 to D11		DMS 92

MISCELLANEOUS

V1	Nuvistor	RCA 6DS4
L1	Inductor	Dynamco A108 0229
T1	Transformer	Dynamco A108 0230
	Socket, nuvistor	Cinch 91/001
	Socket, transistor	Elco 05-3303

6.4 A TIMEBASE BOARD

NOTE: All components on this board are prefixed "2" on the circuit diagram Fig. 13.

Complete printed circuit board assembly

Dynamco 105 0192/3

<u>Circuit</u> <u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
RESISTORS					
R1	4.7K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R2	470	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R3	2.2K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R4	220	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R5	6.8K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R6	5.6K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R7	220	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R8	680	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R9	1K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R10	1.5K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R11	15	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R12	15K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R13	470	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R14	4.7K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R15	5.6K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R16	7.5K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R17	15K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R18	3.3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R19	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R20	Not used				
R21	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R22 to R27	Not used				
R28	4.7K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R29	Not used				
R30 to R32	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R33	15K			Metal Oxide	Welwyn F75
R34	680	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R35	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R36	100K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R37, R38	1.8K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R39	560	±2%	$\frac{1}{4}$ W	Composition	LCA 0309 . . .
R40	820	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R41	68K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R42	470	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R43, R44	220	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R45, R46	Not used				
R47	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R48	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R49	1K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R50	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R51	22K	±2%	$\frac{1}{2}$ W	H.S.	Electrosil TR6
R52	33	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R53	1.2K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R54	22K	±2%	$\frac{1}{2}$ W	H.S.	Electrosil TR6
R55	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R56, R57	150	±2%	$\frac{1}{4}$ W	Composition	LCA 0309

Circuit Ref.	Value	Tol.	Rating	Type	Style
R58, R59	1.8K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R60	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R61	68K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R62, R63	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R64, R65	2.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R66	Not used				
R67	220	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R68	2.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R69	150K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R70, R71	47	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R72, R73	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R74, R75	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R76	2.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R77	1K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.
R78	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R79	2.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B. T. T.

VARIABLE RESISTORS

RV1	5K			Linear	Davall 80P
RV2	250			Linear	Davall 80P
RV3	1K			Linear	Davall 80P
RV4	100			Linear	Davall 80P
RV5	500			Linear	Davall 80P
RV6	5K			Linear	AB Metals Type VA45
RV7	250			Linear	Morganite U

CAPACITORS

C1	Not used				
C2	3.5 - 13p			Ceramic	Steatite 7S Triko 02
C3	0.1	±20%	250V	Min. met. foil	Mullard C280AE/P100K
C4	10p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/ 10p
C5	Not used				
C6	4		40V	Electrolytic	Mullard C426AR/G4
C7 to C10	Not used				
C11	0.1	±20%	250V	Min. met. foil	Mullard C280AE/P100K
C12	100p	±10%	400V	Film & Foil	Wima Tropyfol F
C13	0.1	±20%	250V	Min. met. foil	Mullard C280AE/P100K
C14	Not used				
C15	80		25V	Electrolytic	Mullard C426CB/F80
C16	100p	±10%	400V	Film & Foil	Wima Tropyfol F
C17, C18	80		25V	Electrolytic	Mullard C426CB/F80
C19	Not used				
C20	0.1	±20%	250V	Min. met. foil	Mullard C280AE/P100K
C21	33p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/ 33p

<u>Circuit</u> <u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
C22	80		25V	Electrolytic	Mullard C426CB/F80
C23	22p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/ 22p
C24 to C27	Not used				
C28	10p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/ 10p

TRANSISTORS

VT1	DMS 89
VT2	DMS 93
VT3 to VT6	DMS 95
VT7	DMS 94
VT8, VT9	DMS 95
VT10	DMS 86
VT11 to VT14	DMS 84
VT15, VT16	DMS 95
VT17	DMS 86

DIODES

D1	Zener	DMS 125
D2		DMS 123
D3	Zener	DMS 46
D4		DMS 120
D5	Tunnel	DMS 121
D6		DMS 92
D7	Zener	DMS 46
D8		DMS 92
D9	Zener	DMS 45
D10	Zener	DMS 125
D11	Zener	DMS 45
D12		DMS 92
D13, D14	Not used	
D15, D16		DMS 123
D17		DMS 92

MISCELLANEOUS

SA	Switch, toggle	Waylom MST 105D
V1	Nuvistor	RCA 6DS4
	Socket, nuvistor	Cinch 91/001
	Socket, transistor	Elco 05-3303

<u>Circuit</u> <u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
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6.5 B TIMEBASE BOARD

NOTE: All components on this board are prefixed "3" on the circuit diagram Fig. 15.

Complete printed circuit board assembly

Dynamco 105 0194/3

RESISTORS

R1, R2	Not used				
R3	2.2K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R4	220	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R5	6.8K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R6	4.7K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R7	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R8	680	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R9	1K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R10	1.5K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R11	15	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R12	15K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R13	470	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R14	4.7K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R15	5.6K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R16	7.5K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R17	15K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R18	3.3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R19	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R20	4.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R21 to R29	Not used	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R30, R31	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R32	220	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R33	15K	±5%	2W	Metal Oxide	Welwyn F75
R34	220	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R35	Not used				
R36	100K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R37	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R38	1.8K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R39	560	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R40	820	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R41	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R42	1M	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R43, R44	Not used				
R45	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R46	2.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R47	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R48	1K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R49, R50	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R51	10K	±5%	2W	Metal Oxide	Welwyn F75
R52	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R53	6.8K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.

<u>Circuit Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
R54	2.2K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R55	47	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R56	15K	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R57	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R58	33	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R59	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier B.T.T.
R60	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309

VARIABLE RESISTORS

RV1	5K			Linear	Davall 80P
RV2	250			Linear	Davall 80P
RV3	1K			Linear	Davall 80P
RV4 to RV6	500			Linear	Davall 80P

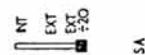
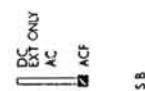
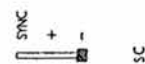
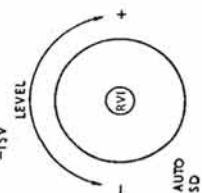
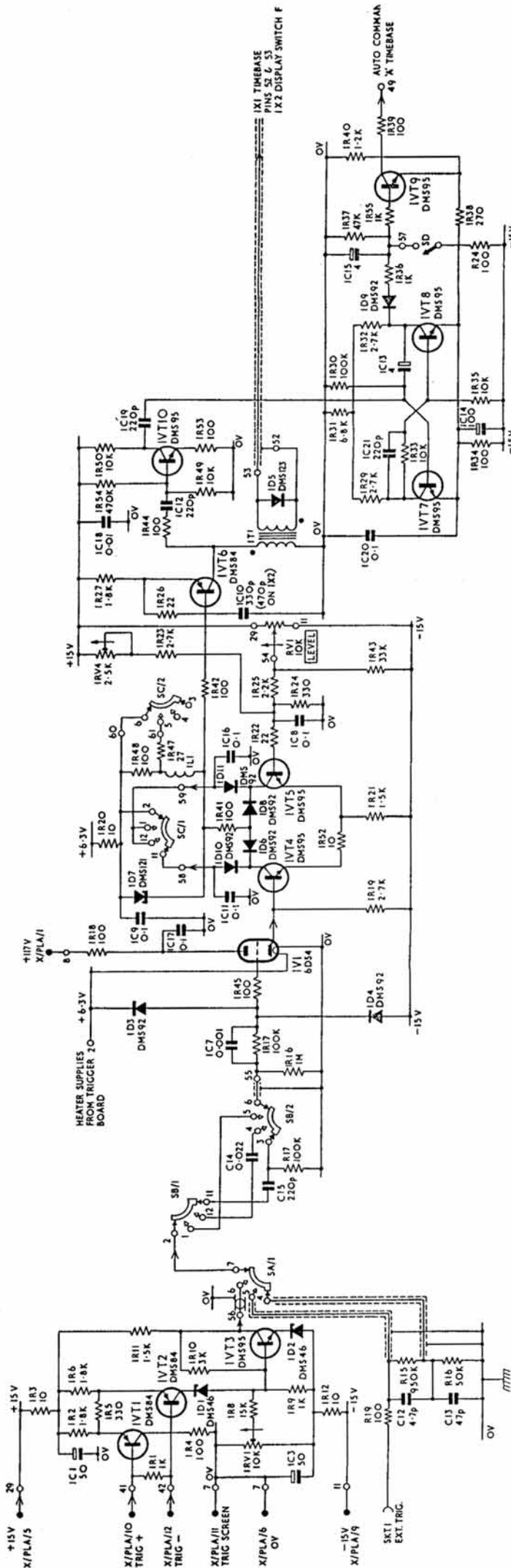
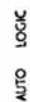
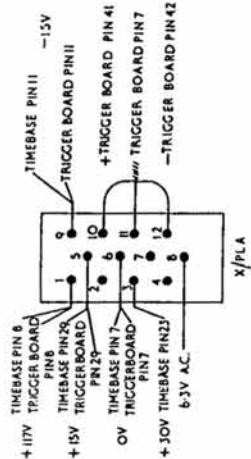
CAPACITORS

C1	Not used				
C2	3.5 - 13p			Ceramic	Steatite 7S Triko 02
C3	Not used				
C4	10p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/ 10p
C5, C6	80		25V	Electrolytic	Mullard C426CB/F80
C7 to C10	Not used				
C11	330p	±10%	400V	Film & foil	Wima Tropyfol F
C12	100p	±10%	400V	Film & foil	Wima Tropyfol F
C13	0.1	±20%	250V	Min. met. foil	Mullard C280AE/P100K
C14	22p	±10%	750V	Ceramic	Lemco CT310NPO/1/R/ 22p
C15	16		40V	Electrolytic	Mullard C426CB/G16
C16	220p	±10%	400V	Film & foil	Wima Tropyfol F
C17	1000p	±10%	400V	Film & foil	Wima Tropyfol F
C18	80		25V	Electrolytic	Mullard C426CB/F80

DIODES

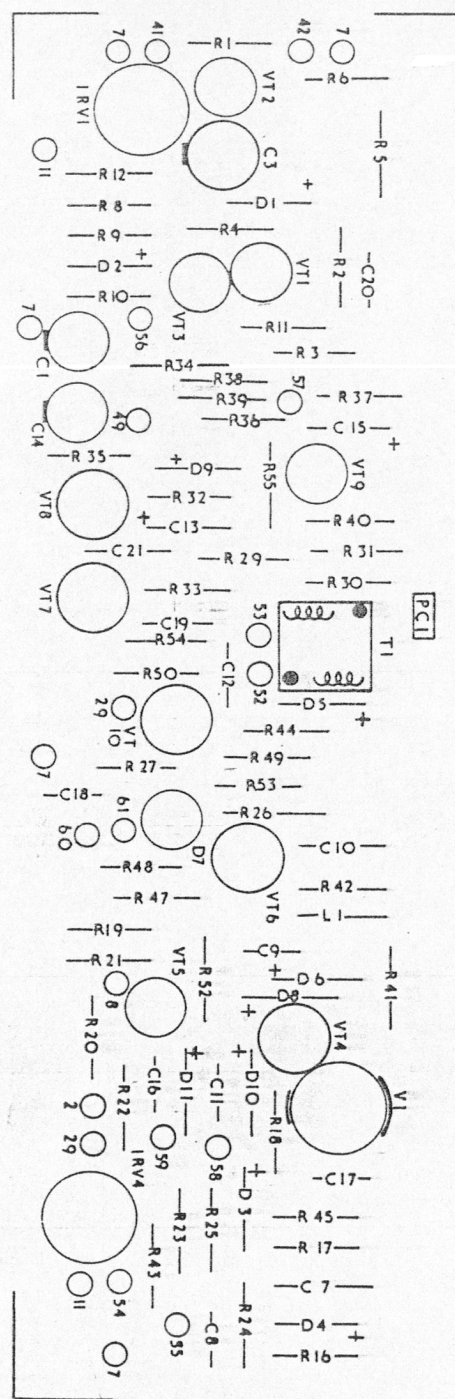
D1	Not used				
D2					DMS 123
D3				Zener	DMS 46
D4					DMS 120
D5				Tunnel	DMS 121
D6					DMS 92
D7				Zener	DMS 45
D8, D9					DMS 92
D10				Zener	DMS 53
D11, D12	Not used				
D13, D14					DMS 92

<u>Circuit</u> <u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
D15				Tunnel	DMS 121
TRANSISTORS					
VT1	Not used				
VT2 to VT6					DMS 85
VT7					DMS 93
VT8					DMS 85
VT9					MD 7000
VT10	Not used				
VT11					MD 7001
VT12, VT13	Not used				
VT14					DMS 85
VT15	Not used				
VT16					DMS 85
MISCELLANEOUS					
V1				Nuvistor	RCA 6DS4
	Socket, nuvistor				Cinch 91/001
	Socket, transistor				Elco 05-3303

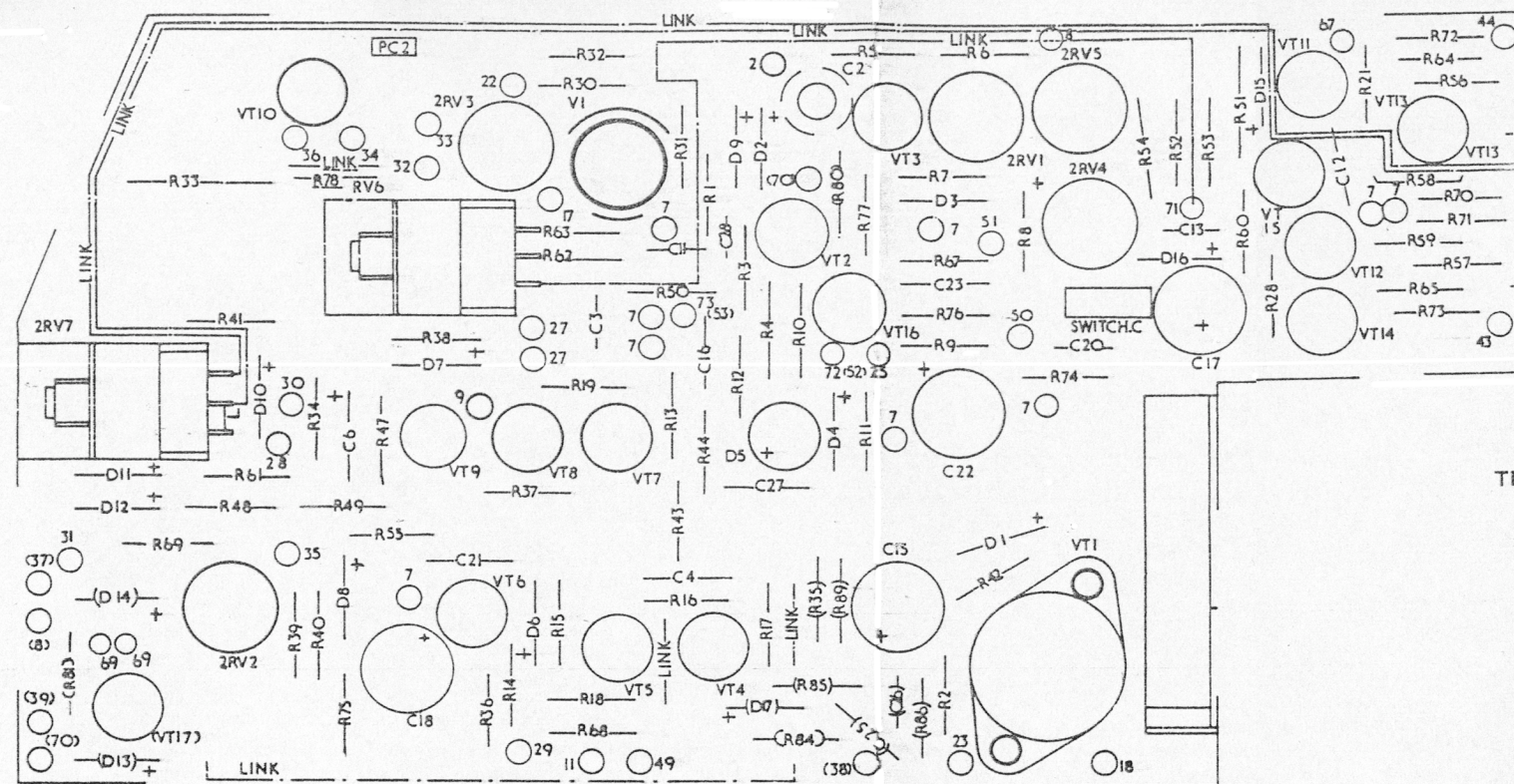


TRIGGER CIRCUIT DIAGRAM

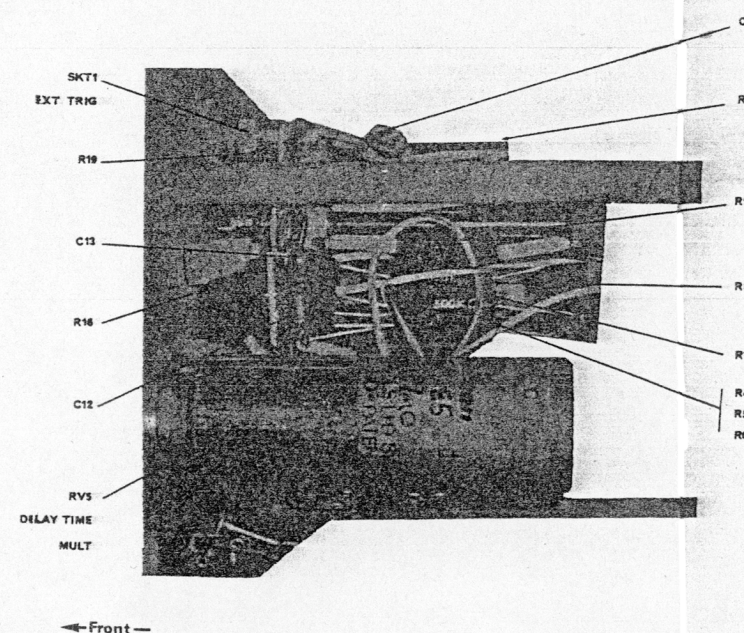
FIG.11



TRIGGER BOARD LAYOUT

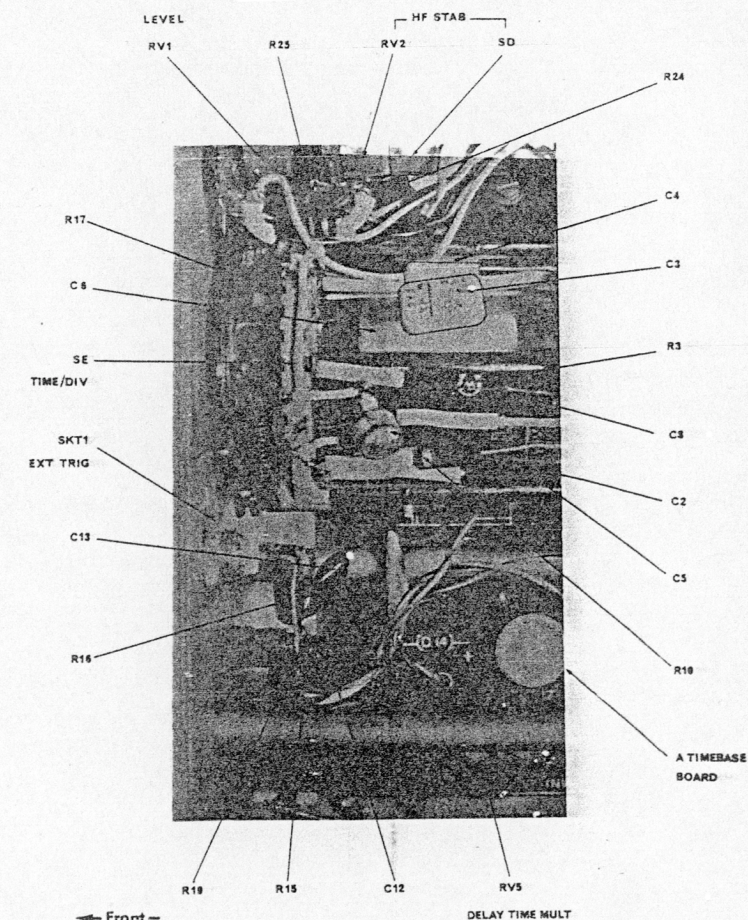


TIMEBASE BOARD LAYOUT



← Front →

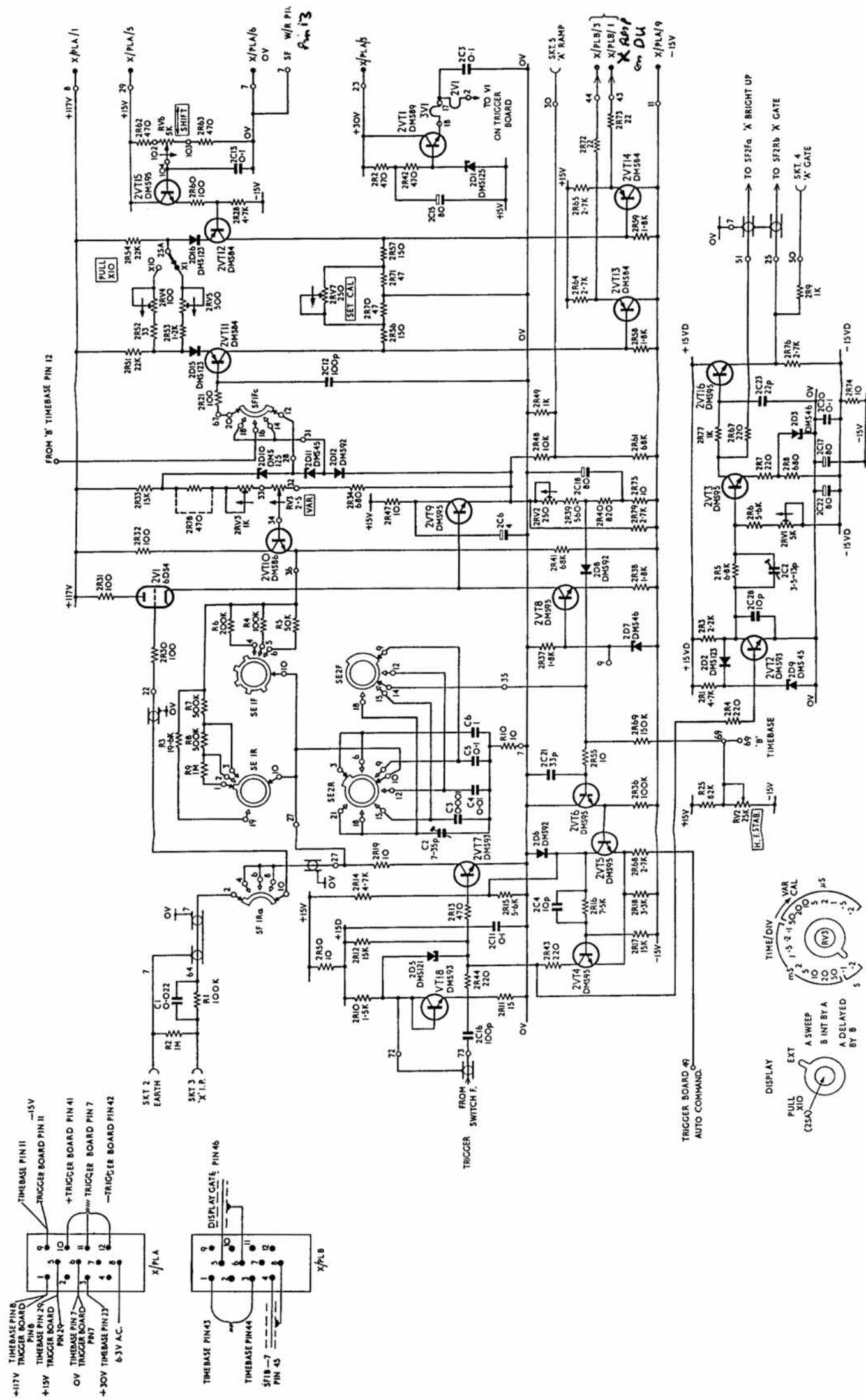
A TIME/DIV SWITCH-UNDER VIEW



← Front →

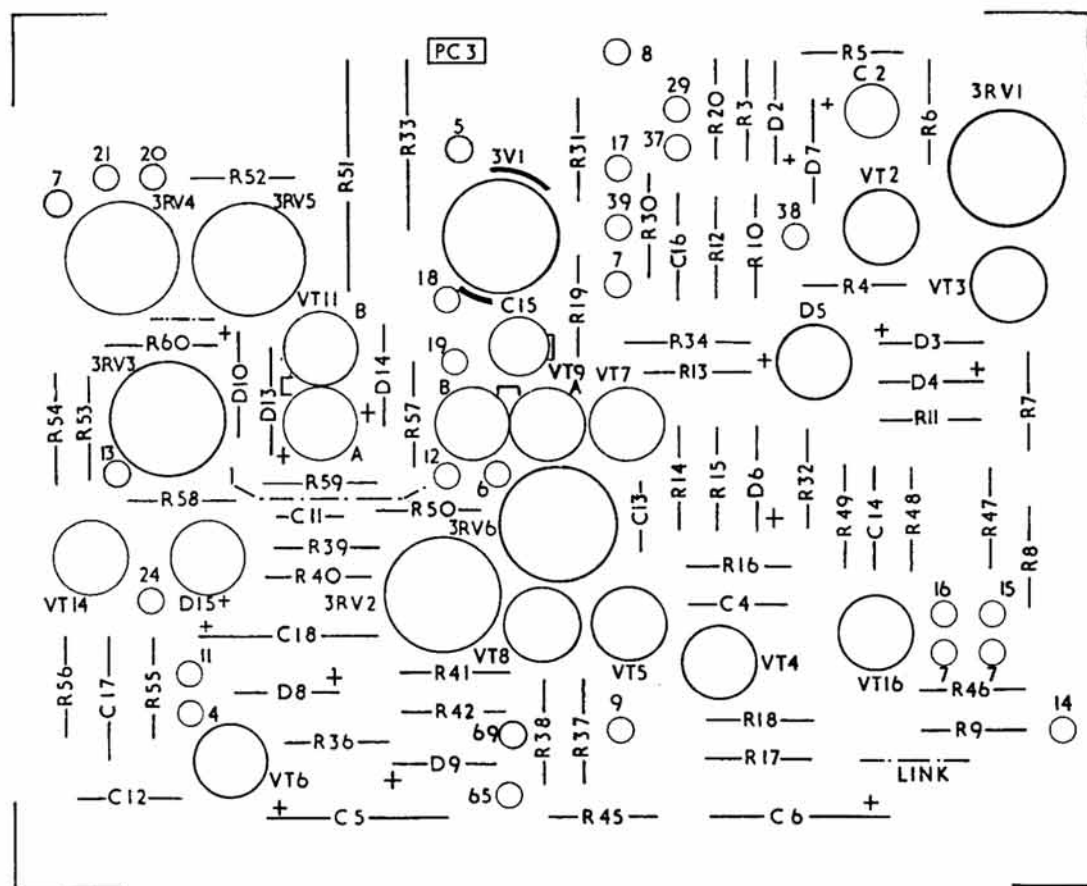
A TIME/DIV SWITCH-RIGHT SIDE

FIG.12 COMPONENT LOCATION

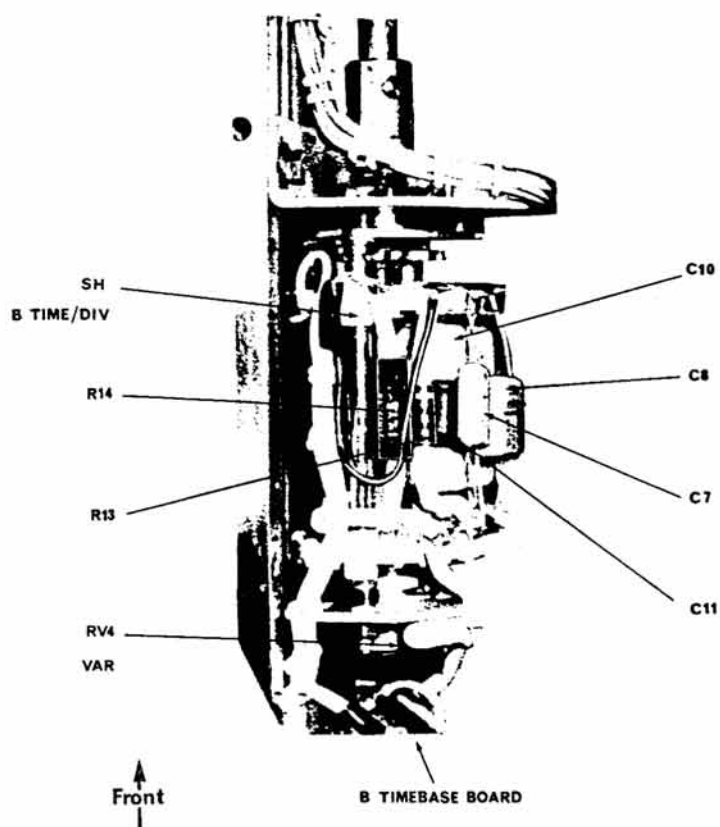


SE
SF

A TIMEBASE CIRCUIT DIAGRAM FIG.13



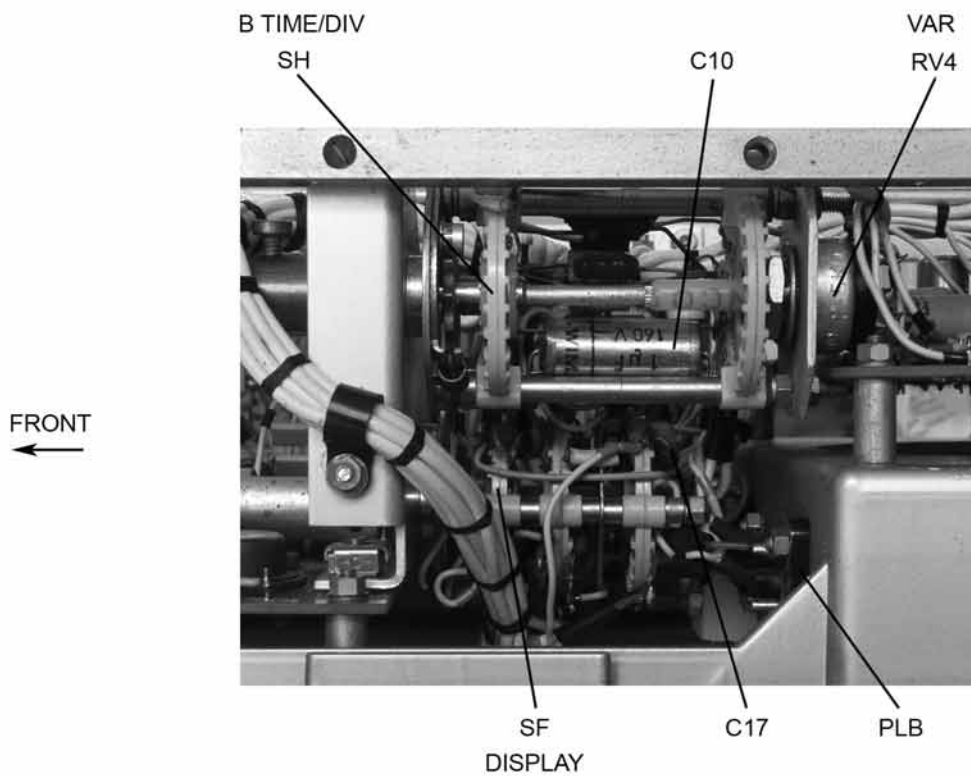
B TIMEBASE BOARD LAYOUT



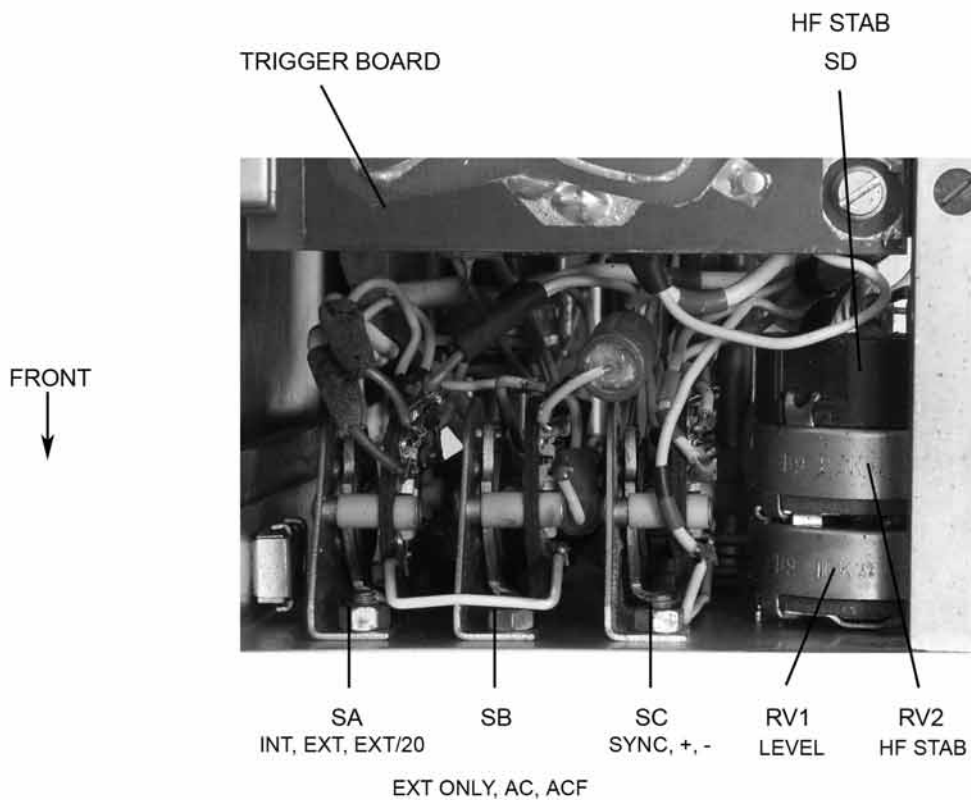
B TIME/DIV SWITCH
RIGHT SIDE

FIG.14

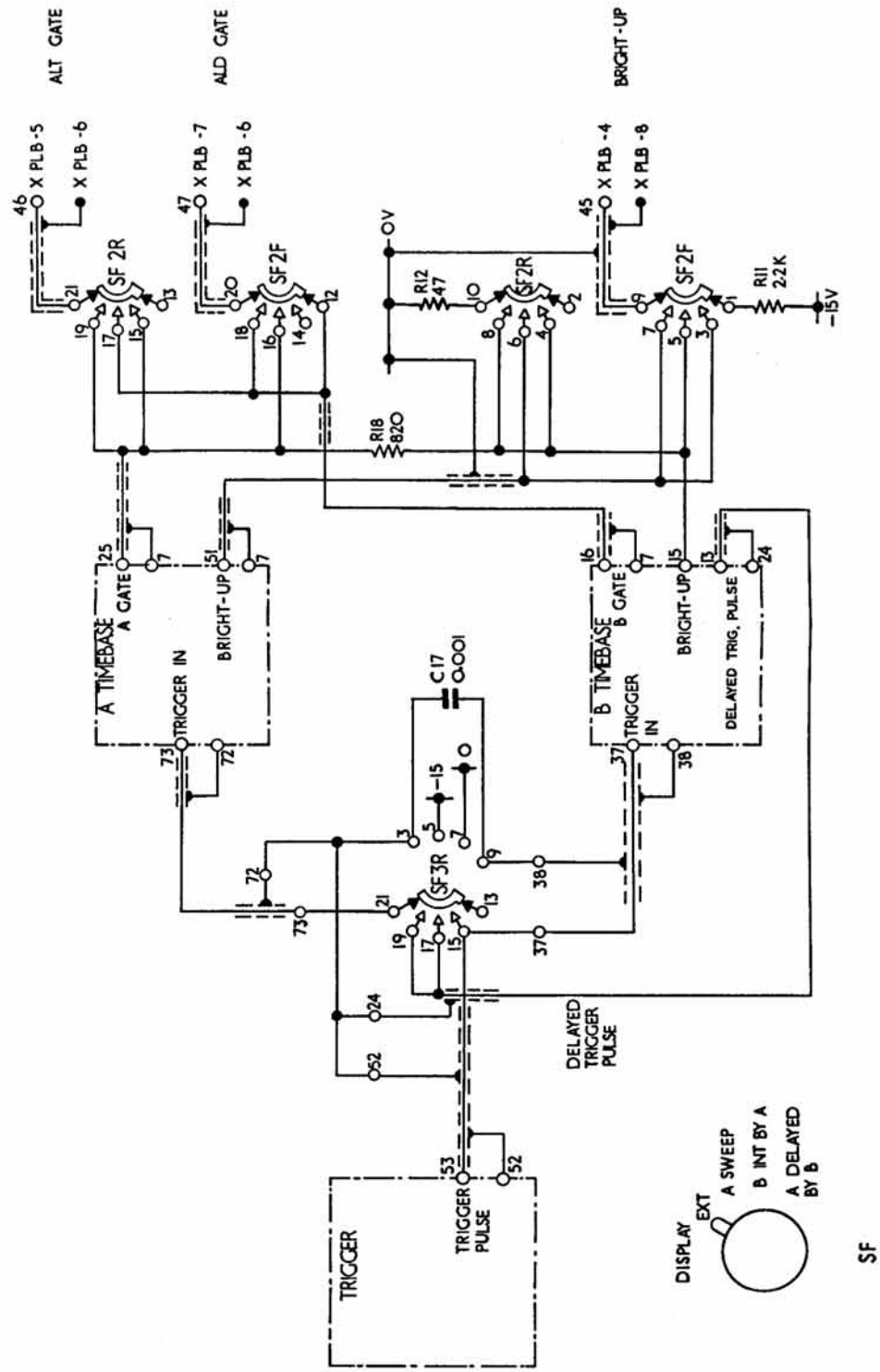
COMPONENT LOCATION



B TIME/DIV SWITCH- UNDER VIEW



TRIGGER SWITCH- TOP VIEW



DISPLAY SWITCHING DIAGRAM FIG.17